The New Zealand
Journal of Agriculture.

VOL. 54. WELLINGTON, 20TH JANUARY, 1937. No. 1.

JOHNE'S DISEASE.

E. H. STEPHENS, Veterinarian, Stratford, and DUDLEY A. GILL, District Superintendent, Live-stock Division, Wellington.

JOHNE'S disease is a slowly developing, chronic inflammation of the intestines which eventually causes the affected animal to scour uncontrollably, so that it becomes greatly emaciated and dies of sheer exhaustion.

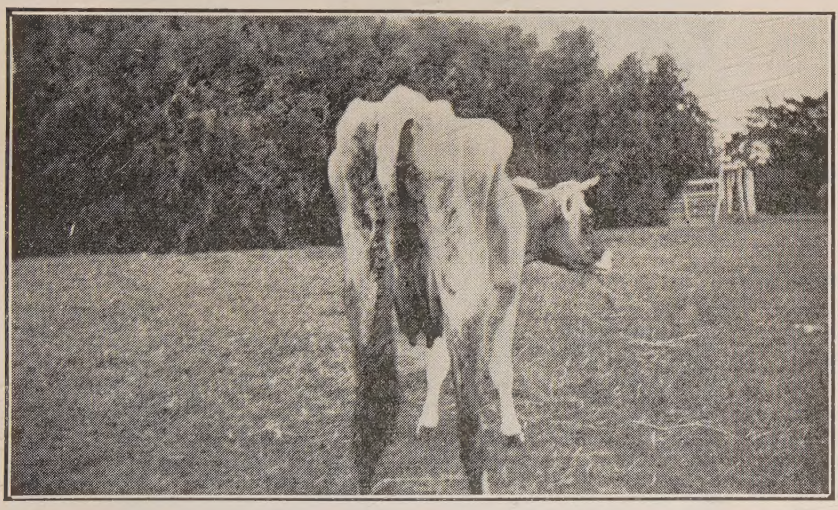

FIG. 1. TYPICAL ADVANCED CASE OF JOHNE'S DISEASE.
Note the emaciation and evidence of scouring.
[*Photo kindly supplied by H. R. Denize, Stock Inspector.*

Sheep are occasionally infected with the disease, goats may contract it also, and it has been recorded in a herd of deer. It seems to be a disease to which any ruminant is more or less susceptible, although cattle are the only ones commonly affected. Dairy breeds are more commonly affected than beef breeds, but that is probably due to the strain of calving and milk-production lowering their powers of resistance, and also to the fact that beef cattle are slaughtered at a comparatively early age. It is considered that there is no difference in

the susceptibility of the different dairy breeds. Naturally if one breed predominates in an infected country the cases will occur mainly in that breed.

A point which requires stressing is that Johne's disease spreads very slowly. Acute diseases, such as swine fever or foot-and-mouth disease, sweep through a herd in a few days, but that is far from being the case with Johne's disease. Even on a badly infected farm it is seldom that more than three or four clinical cases—*i.e.*, cases showing recognizable symptoms—occur in any one year.

The Cause.

Johne's disease is caused by a microbe that is similar in many ways to the bacillus of tuberculosis. Especially does it resemble the type of tubercle bacillus that affects birds. Indeed for many years after the cause was first discovered by Professor Johne in Dresden in 1895, it was thought to be a peculiar form of intestinal tuberculosis and was called "paratuberculous enteritis."

Although there is evidence to suggest that the disease was present in Europe at least 100 years ago, and there is no means of knowing how much longer it was in existence before that, it was only in 1895 that Johne first detected the causal organism in the bowel lesions. Even then there was no proof that this microbe was really the cause, as Johne, and others who attempted it after him, were unable to grow it and consequently experimental work on the usual lines could not be undertaken. It was not until 1912 that Twort and Ingram found the means of growing this bacillus in the laboratory. The difficulty arose through the fact that Johne's bacillus has very peculiar growth requirements and does not grow at all on any of the media commonly used for culturing micro-organisms. In addition to that, even when a suitable medium for growth was found, the bacillus grew so slowly that only after several weeks' incubation was it sufficient to be detectable with the naked eye, whereas the majority of microbes give easily visible colonies in a few days at most. Only within the last three or four years have improved media been evolved which give a visible growth of Johne's bacilli in a somewhat shorter time.

Then, too, it is possible with almost all diseases to study them by using small animals such as rabbits, mice, or guinea pigs, but Johne's disease cannot be transmitted regularly to any of these species, and this fact was, and still remains, a very serious obstacle in the way of research work.

It is necessary to mention these facts so that it may be appreciated why our present knowledge of Johne's disease has taken so long to acquire, and why even now that knowledge is far from complete.

Symptoms.

The earliest symptoms shown by an affected animal are a tendency to loose bloom and to have a harsh staring coat. There is nothing in this on which a diagnosis can be based, and many other diseases, of which tuberculosis is one of the commonest, produce similar early indications of their presence. But in a herd where Johne's disease is known to occur these signs, manifested at a time when the feed conditions are such that the rest of the herd is thriving well, should always be regarded with suspicion.

Later there is scouring and more rapid wasting. The diarrhœa is often intermittent at first, and the cow, after scouring and losing condition for a fortnight or so, apparently recovers and puts on flesh again only to have another attack of scouring a few weeks later. The intervals between attacks of diarrhœa become shorter, and finally persistent scouring sets in, quickly reducing the animal to a skeleton, and death from weakness and exhaustion puts an end to the case.

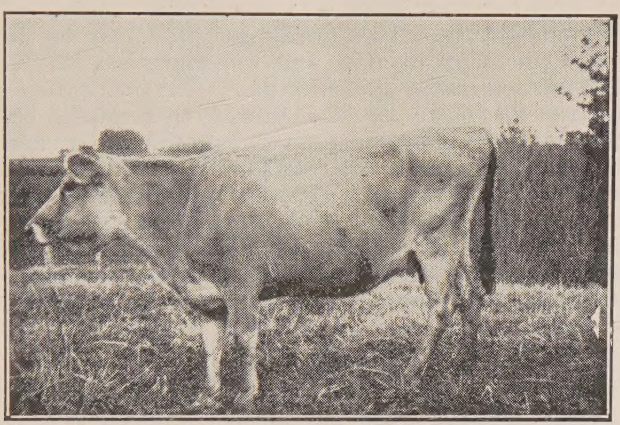

FIG. 2. A CASE OF JOHNE'S DISEASE.

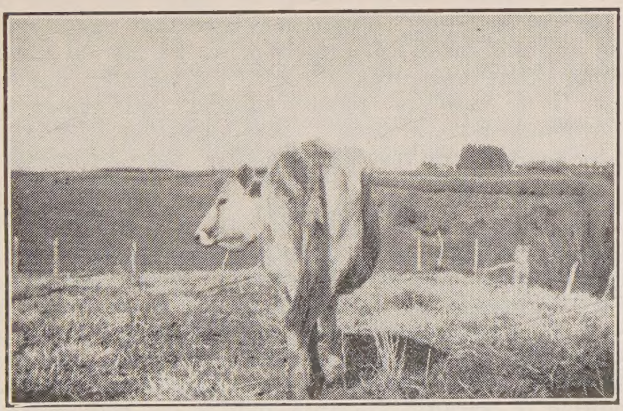

FIG. 3. ANOTHER ILLUSTRATION OF A CASE OF JOHNE'S DISEASE.

In other instances an animal may show no sign whatever till persistent scouring occurs, when it quickly wastes and may die in two or three weeks. This is fairly common just after calving in affected cows, and the rapidity with which some such cases will waste and die under the effects of the continuous scouring is remarkable.

In the more slowly developing type of case, with intermittent attacks of diarrhœa, there are two symptoms which, *while they do not invariably appear*, are useful aids to diagnosis. One of these is the

appearance of a dropsical swelling under the throat and jaw and the other is a tendency to waste more markedly about the hindquarters, especially the thighs and buttocks, than in other parts of the body. Below are two photographs of a case which demonstrates these two points very clearly.

The affected animal shows no sign of illness other than the wasting and diarrhœa. She is not feverish and continues to eat. Naturally her milk-yield falls away, and as a result of the diarrhœa and consequent loss of fluid from her body there is generally great thirst.

The symptoms that have been briefly described here are not shown, unfortunately, till many months, and sometimes several years, after the animal first contracted the infection. The incubation period in Johne's disease—that is to say, the interval that elapses between the time infection takes place and the time when symptoms are first shown—is seldom less than one and a half years and is often much longer than that. Consequently symptoms are not often seen in very young animals; wasting and scouring frequently occur in yearlings, but this is almost invariably due to worms in the fourth stomach and intestine—not to Johne's disease. It is in animals from two years old upwards that scouring *for no apparent reason* should be considered suggestive of Johne's disease.

Treatment.

There is no known cure for this disease. If treatment for diarrhœa is given during the stage when intermittent scouring is taking place, it may seem to have a good effect, but actually the diarrhœa would have ceased for a time in any case, and will later occur again in spite of any treatment. In countries where cows are of higher beef value than they are here a form of treatment is sometimes used that temporarily checks the scouring and enables a little condition to be put on the beast by special feeding before it is disposed of to the butcher, but, as stated above, there is no cure for Johne's disease, and money spent on medicines is money thrown away. In addition to that it is merely continuing to endanger the rest of the herd to keep an infected animal alive.

Prevention.

A beast that is scouring with Johne's disease passes large numbers of the causal organism in its droppings. Hence the pasture and drinking-water of the other cows are apt to be infected, and in this way the disease is spread amongst them. Unfortunately Johne's bacillus can remain alive in soil and water for a long time. The exact time that it can survive is not known, and undoubtedly it varies according to the condition of warmth, moisture, and so on, that the bacillus is exposed to, but under conditions which favour it it can probably survive for between one and two years.

Swampy, low-lying areas are considered to especially favour the survival of the bacilli deposited on them by infected cattle, and to be important sources of fresh cases of the disease on affected farms. It is essential that such areas be either drained and heavily limed, or, if this is impracticable, fenced off completely. Apart altogether from Johne's disease swampy areas tend to harbour infectious diseases of all sorts—both bacterial and parasitic—and to deal with them in one or other of these ways is always highly desirable.

There is a widespread belief in Britain and elsewhere that infection is more readily conveyed to cattle by drinking water that is contaminated with Johne's bacilli than by grazing, and this is probably correct. Thus ponds, swampy pools, and other such surface waters which the cattle can stand in as well as drink from are especially dangerous, and should be replaced wherever possible by concrete drinking-troughs, which are less liable to contamination and can be kept clean. The farmer seldom realizes the potentialities of such contaminated water-supplies for conveying disease amongst his stock. It does not apply only to Johne's disease, but to tuberculosis and infectious diseases generally.

Chain-harrowing paddocks that have harboured infected cows is a most useful aid in control, as the beasts' droppings are then broken up and the sun is afforded a chance to dry them thoroughly and sterilize them. Sunlight is one of the most powerful disinfectants, but it needs to be given a chance.

Heavy dressings with burnt lime are to be recommended. They are considered in France, where Johne's disease is very common in certain areas, to have given good results, and in the Channel Islands also the liming of infected pastures is claimed to have been most beneficial in reducing the incidence of fresh cases. How burnt lime produces the effect claimed for it is not known, but it may act through some effect on the soil rendering conditions in it unfavourable for the bacillus so that it dies out.

It will be apparent that while these preventive measures have a highly important part to play, something more is required if much real headway is to be made. Especially is there need for some means of detecting animals in the early stages of the disease before symptoms are shown. Unless this can be done we have very little hope of controlling the spread of the disease through the country, because of the fact that an infected animal may be capable of infecting others for some years before showing symptoms itself. During those intervening years it may carry the infection into several herds. An instance of this sort was brought to the writer's notice recently: A pedigree bull was sold by A to B. Some four years later Johne's disease began to appear in B's herd. In the meantime the bull had been sold to C. About three years after his arrival, Johne's disease appeared in C's herd, and eventually the bull himself died of it. While there is no actual proof, inquiry provided strong circumstantial evidence that this seemingly healthy bull had carried the disease into both herds. Fortunately we now have a test which can be used to detect the presence of Johne's disease in the early stages.

The Johnin Test.

There is no need here to discuss the development of this method of testing for Johne's disease. It will suffice to say that it is done by injecting small quantities of Johnin (similar to tuberculin) into the animal's skin and noting the result. It is very similar to the modern method of testing for tuberculosis. The test is completed in seventy-two hours, and does not affect the cow in the slightest. This latter point is mentioned, as an owner sometimes expresses a fear lest the application of the test should put a cow off her milk.

It is not as reliable as the tuberculin test, and a great deal of skill and experience is required to apply and interpret the results of the test properly, but in the hands of an experienced veterinarian it can give the greatest assistance in detecting early cases of the disease.

Johne's Disease in New Zealand.

There can be no doubt that it was introduced here in infected, but apparently healthy, imported cattle. That is how it has reached all new countries, and considering what has been said above regarding its lengthy incubation period, coupled with the fact that until recent years there was no means of detecting such animals, it is not surprising that it should have been spread in that way.

The first case that was ever shown to be Johne's disease in New Zealand occurred in an imported cow in 1912. The animal was destroyed and instructions issued to field officers that specimens from any animal showing suspicious symptoms were to be sent to the Wallaceville Laboratory for examination. That instruction was issued because it was considered very probable that other imported animals besides the one detected and killed might well have brought the disease in during previous years.

As a result of this a number of specimens were received from time to time and examined at Wallaceville, but none was confirmed. Nevertheless the disease must have been present, for in 1928 specimens were received from a suspicious cow near New Plymouth, and examination showed it to be a well-marked case of Johne's disease. This occurrence reawakened interest in the disease. It was at once realized that this was unlikely to be the only case, and inquiries were immediately started. They revealed that a condition of this sort had occurred on several farms, but the owners had not reported the affected animals to the Department, as they attributed the scourings to various non-infectious causes, such as a "chill," unsuitable food, retention of part of the afterbirth, ragwort poisoning, and so on, and, while the history of the cases aroused suspicion, there was no definite evidence that they were, in fact, cases of Johne's disease. That being so a search had to be made for actual cases, and it was only after considerable time that these were eventually found.

Johne's disease was scheduled under the Stock Act in 1931 in order to give departmental officers the requisite authority to slaughter infected animals and pay compensation for them. Since the rediscovery of Johne's disease in 1928 the Department of Agriculture has been active in its inquiries concerning the disease both in this country and abroad, and has taken advantage of all fresh information that has come to light, particularly as regards methods of testing cattle to detect the presence of the disease before symptoms are shown.

At the present time in New Zealand we know of its presence on several farms in Taranaki and the Waikato, and it is likely that it is also present to a slight degree, and as yet undetected, in certain other dairying districts.

The action the Department is taking to check the spread of the disease as far as possible may be outlined briefly as follows:—

To protect the whole Dominion from Imported Infection.—All imported cattle, from whatever country, must be accompanied by a veterinary certificate that they passed the Johnin test prior to shipment.

To protect the South Island.—In view of the disease being as yet unknown in the South Island, all dairy cattle going from the North Island to the South Island must pass the Johnin test applied by a Government Veterinarian before they are allowed to leave the farm of origin.

To limit the Spread of Infection in the North Island.—The best means of accomplishing this has been the subject of long and very careful consideration of all aspects of the question. It is a far more complicated matter than may be easily realized and the Department has no intention of binding itself to any hard-and-fast policy. It can be said at once that there is not now, nor will there be, any intention of slaughtering out infected herds. Such a measure, with full compensation to the owner, would be the best means of all if we knew definitely that the disease was limited to a few herds, but the time when any such action were possible has long since gone past.

It is the intention to interfere as little as possible with the normal practice on affected farms. Apart from a desire to inflict as little hardship as possible on the farmers concerned, the Department is actuated also by the fact that any drastic action would inevitably lead to concealment of the presence of the disease, and although slightly more drastic action than it is intended to take might be more effective on the farms where it could be put into operation, there would in reality be little to gain and a great deal to lose by being too severe.

The action now being gradually brought into operation is that affected herds are to be tested with Johnin at half-yearly intervals and the reactors slaughtered. Compensation will be paid in accordance with the provisions of the Stock Act. The owner must notify the Department of any intending sales of stock, and these will, if considered necessary, be tested again prior to sale. Inspection of the farm itself will be made and advice given on general lines of prevention, including management of the herd and matters such as draining and liming of pastures.

For the past two years this line of action has been in operation in two grade herds in Taranaki, and the progress made with this experimental trial warrants the hope that with the co-operation of the farming community the method will go a long way towards checking the spread of the disease.

Farmers having suspicious cases are urged to report them without delay to the nearest office of the Department. It is obviously in their own interests as well as to the advantage of the dairy industry as a whole that they should do so.

While the normal high quality of New Zealand meat has been well maintained, it seems to behove us to ask whether this suffices in view of developments in the world's meat trade. It probably may be said with truth that quality is of more value in meat-marketing now than it ever was before. Some of our competitors in the world's meat-markets assiduously have been increasing not only their output but the quality of that output. In regard to lamb, for instance, the point may have been reached where there is danger that our supremacy in regard to quality—a supremacy which is so valuable to us—may be challenged. The New Zealand sheep industry cannot face such a possibility with equanimity. Fortunately there is no clear reason why its previous valuable eminence in respect to quality of lamb and mutton cannot be maintained.—*Annual Report, Director-General of Agriculture.*

POTASH TOP-DRESSING OF AUCKLAND PASTURES.

RESPONSE FROM POTASH AT WAIHI.

J. E. Bell, Instructor in Agriculture, Pukekohe.

(Concluded.)

Responses in other Districts.

In other districts responses to potash are not so consistent, and cannot be confined to one soil type or to one locality. Nevertheless, isolated striking responses have been obtained on all soils—on peat, on sand, loams, clays, and silts. There is little doubt that as experimental work progresses soil types in some localities will be recognized to be potash-deficient to some degree. In different localities and soils the pastures vary somewhat, but the method of improvement by potash is the same in principle.

On the gum-land soils of the northern parts of the province a common poor sward is brown-top dominant. Common clovers in such a sward are *Lotus* species and white clover. One observational trial at Waimauku, Waitemata County, on such a soil was laid down on a dominant-brown-top sward with much Chewings fescue and rib-grass and a scarcity of clovers. A casual inspection did not reveal the presence of better grass species in the sward which was improved in the following sequence by the use of superphosphate plus lime plus potash. First there was an increased growth of *Lotus hispidus*, *Lotus major*, subterranean clover, and white clover. The ascendancy of the subterranean clover was marked first, and later the white clover overtopped the subterranean clover and subdued it. Improvement in the better grasses did not occur until the white-clover dominant stage was reached, when many plants of rye-grass, paspalum, cocksfoot, and crested dogstail appeared prominently in the sward. The Chewings fescue has almost entirely disappeared from view, but the more virile brown-top is still there, although not prominent, and has changed in appearance from a dull hue to a healthier deeper green colour, after only two years. The difference between the superphosphate plus lime plus potash plot with its thick carpet of white clover and vigorous rye-grass and crested dogstail and paspalum, and the superphosphate plus lime plot with its less vigorous sward of clovers and inferior grasses is quite striking. Other plots included one treated with lime and potash, and at one of the early inspections it was noticed that this plot had arrived at a stage when subterranean clover was the dominant clover, while the superphosphate plus potash plus lime plot had arrived at the stage where white clover was in the ascendant. The lime plus potash plot did not get much beyond the subterranean-clover-dominant stage and white clover did not flourish through phosphate deficiency. Consequently there was not much further improvement in the lime plus potash plot beyond the brown-top - subterranean - clover stage. The vigorous white-clover - dominant stage could only be reached by the use of superphosphate plus potash plus lime. Without a thick vigorous sole of white clover the mat of brown-top remained unchallenged by better grasses. Superphosphate and lime alone or combined could not bring

FIG. 5. NO POTASH (EXPERIMENT NO. 306).

A sward of catsear, lamb's tongue, and other flat weeds and stunted suckling clover, with some weak rye-grass, fog, *Poa pratensis* (in flower), and cocksfoot and sweet vernal. Where is the white clover? [*Photo by H. Drake.*

FIG. 6. POTASH (EXPERIMENT NO. 306).

Compare with Fig. 5 taken from sward alongside. Note the increase in suckling clover, and white clover has swamped the weeds. Note, further, how the white clover has miraculously appeared and is shading the suckling clover, the vitality of which, now at its height, will diminish due to lack of sunlight.

[*Photo by H. Drake.*

about this much-desired white-clover growth. The effect of lime in addition to superphosphate, or superphosphate in addition to lime, was as nothing compared with their effect where potash was also used. Thus lime in addition to superphosphate gave only a slight benefit, whereas lime in addition to superphosphate plus potash made quite an appreciable difference. In the same way superphosphate in addition to lime showed minor differences, while superphosphate in addition to lime plus potash gave an almost magical improvement. Potash used alone was useless or perhaps detrimental to a very slight degree. Used with lime its effect was slight and with superphosphate quite good, but not to be compared to where used with superphosphate plus lime. This trial was the first one in which the effect of potash was noted on a sward deficient to a large degree in potash, and most of the principles of potash response which were demonstrated there have since been found to apply equally to other swards on other soils, including the sandy loams of Waihi.

On a loam soil, apparently the result of a volcanic ash shower, at Runciman, Franklin County, the potash has increased by 100 per cent. the extent of the rye-grass, white and subterranean clover cover of the ground and has decreased the rib-grass, where it was applied in addition to superphosphate and lime. Here the effect of potash to the eye was very small compared with the effect at Waimauku, for the superphosphate plus lime plot contained quite a fair sole of rye-grass and clover. Potash here, though very useful, could not be claimed to be definitely payable as a top-dressing. There are many trials where potash effects small increases and where its use may not be payable. At Runciman as at Waimauku, potash was most effective where the lime and phosphate deficiences had been met, and it also added to the effectiveness of lime and superphosphate.

On peat land at Kaipaki, Waipa County, potash has greatly improved the pasture sward: applied to a poor paspalum sward it has greatly increased the white-clover, suckling-clover, and *Lotus major* growth: white-clover growth was most improved on the superphosphate plus potash plots. At Orewa, Waitemata County, on a sandy soil overlying an ironstone pan, potash showed early improvement in the growth of *Lotus major* and white clover. Here the speed and the extent of further improvement may be limited by lack of soil moisture in summer due to the iron pan. On one trial at Mauku, Franklin County, on basic volcanic soil, a trial has shown responses in white-clover growth on the potash-treated plots. The plot was placed on a field subjected to much cutting for ensilage. Another trial at Ramarama, Franklin County, on a similar soil, has shown also a very strong potash response in increased clover vigour on a field subjected to much cutting for hay. Fields subjected to much cutting for hay or silage appear liable to suffer from potash deficiency.

A trial at Waiau Pa, Franklin County, on a gum-land silt, shows the inefficiency of potash where a large lime deficiency is not first corrected. With lime—and phosphates—potash has given increased growth of white clover; without lime potash proved detrimental. This brings out the important point that on lime-deficient soils potash may prove detrimental if the lime deficiency is not first corrected; this sometimes occurs both on soils that do respond to potash and those that do not.

Of course, on soils where there is little or no lime deficiency the use of potash without lime can make full improvement. Thus, on one other trial at Waiau Pa, on a lighter soil not very responsive to lime, potash is equally effective in increasing white clover on both limed and unlimed areas.

Besides trials showing strong and payable potash responses, there are many trials where it shows to a very slight and apparently unpayable extent. In these trials phosphates or phosphates plus lime dressings are sufficient for white-clover establishment, and continued growth and high production can be obtained without potash. On a large number of trials potash shows no response whatever.

FIG. 7. NO POTASH (EXPERIMENT NO. 302).

A sward of sweet vernal, weak rye-grass, and rib-grass, with some weak white clover, *Lotus major*, and cocksfoot and hair-grass. Photo taken in winter. Compare with Fig. 8.

[*Photo by H. Drake.*

All the observations in this article are based on the effect of annual dressings of 30 per cent. of potash salts at 2 cwt. per acre. These are heavy applications, made purposely so that soils deficient in potash to the slighest degree can be more easily detected. Yet even so, in some trials the increases due to potash appear so great that these heavy and costly applications appear payable. The first task is to locate soils responsive to potash. The next is to lay down, on potash-responsive soils, trials devised to show the effect of smaller amounts of potash than 2 cwt. so that fairly definite advice can be given as to the economic quantity to apply.

Thanks are due to the numerous farmers who placed fields at the disposal of the Department for the experiments.

Summary of L.P.K. Trials at Waihi and other Localities.

Plots are pegged out in farmers' pasture fields, and the different plots are top-dressed with different treatments or combinations of treatments. The common type of trial is called the L.P.K. observational trial, which is laid down to locate the responses to carbonate of lime and 30 per cent. potash salts. In the L.P.K. trial the lime and potash are applied at heavy rates, so that differences can be more readily discovered, the lime being applied at the rate of 1 ton per acre at laying-down and at 5 cwt. per acre thereafter annually, the potash at

FIG. 8. POTASH (EXPERIMENT NO. 302).

Taken in winter when growth is not vigorous, nevertheless the photo shows the enormous improvement caused by potash. As the white clover assumes charge the previously stunted and inconspicuous rye-grass grows vigorously, poor-producing grasses and weeds, such as hair-grass, catsear, and lamb's tongue, disappear. The better grasses appear more prominently in the sward because they grow better, and in tillering occupy wider territory.

Note the prominence of rye-grass and elimination of hairy flat weeds and *Lotus major*, and almost complete eradication of rib-grass. Sweet vernal is still present, but suckling clover, which was prominent shortly after the application of the potash, has almost entirely disappeared. [*Photo by H. Drake.*

2 cwt. per acre annually, the phosphate (superphosphate) being applied at the normal rate of 3 cwt. per acre annually. The L.P.K. trial comprises eight plots as follows:—

(1) No manure.
(2) Superphosphate.
(3) Superphosphate plus potash.
(4) Potash.
(5) Lime.
(6) Lime plus superphosphate.
(7) Lime plus superphosphate plus potash.
(8) Lime plus potash.

FIG. 9. SUPERPHOSPHATE (EXPERIMENT NO. 389).

A poor sward of paspalum and stunted suckling and white clovers on peat (Kaipaki peat loam, Waipa County). Superphosphate alone has not increased clover-growth. *[Photo by H. Drake.*

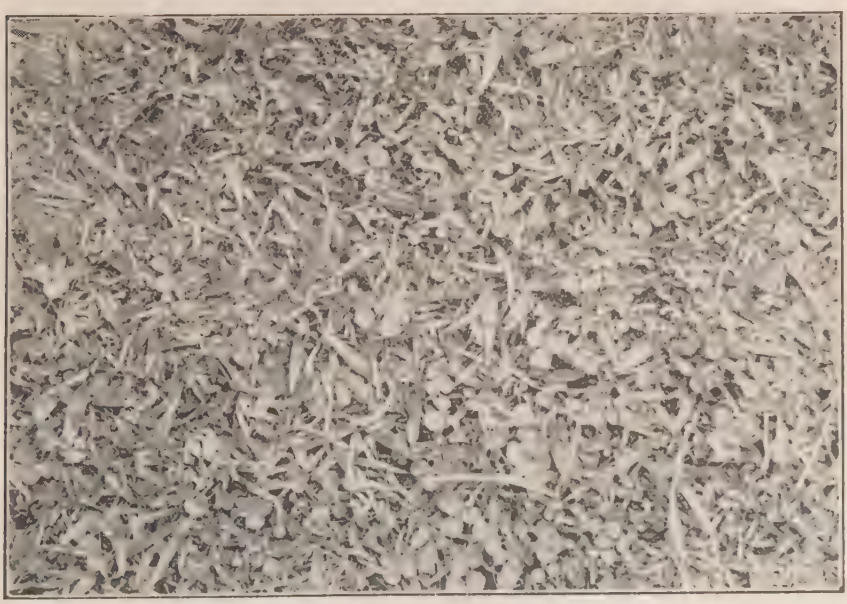

FIG. 10. SUPERPHOSPHATE PLUS POTASH (EXPERIMENT NO. 389).

Superphosphate and potash together have greatly improved white-clover growth. (See Fig. 9.) *[Photo by H. Drake.*

The trials are laid down in duplicate. Comparisons are effected by observations carried out every three months, and the effects of the different treatments are noted thereby every season of the year. Not only is the effect noted, but the degree of the effect is recorded by numerals 1 to 5, indicating the superiority to the untreated plot. Thus, 0 indicates no improvement or detriment over the untreated plot, 1 slight, 2 fair, 3 good, 4 very good, and 5 excellent responses by the particular treatment.

The following table shows the responses on many of the trials in the Auckland Province where good potash responses have been obtained, and of all the trials at Waihi that have been down two years.

Trial.	Locality.	Soil Type.	Response to			
			Superphosphate.	Superphosphate plus Potash.	Lime plus Superphosphate.	Lime plus Superphosphate plus Potash.
16/1/299	Waihi ..	Sandy loam ..	0	3	0	3
300	,, ..	,, ..	1	2½	1	2½
301	,, ..	,, ..	0	3	0	3
302	,, ..	,, ..	½	4½	1	4½
304	,, ..	,, ..	½	3	½	3
306	,, ..	,, ..	1	3½	1½	4½
303	,, ..	Alluvial loam ..	2	2	2	2
305	,, ..	,, ..	1	1	1	1
307	,, ..	Peat over alluvial ..	½	1	½	1
151	Kaihere ..	Deep peat ..	0	1	1	3
245	Patumahoe ..	Loam	1	2½	1½	2½
246	Ramarama ..	Clay loam ..	½	3	½	3
250	Waiau Pa ..	Clay	2	1	2½	4
262	Mauku ..	Loam	½	3	½	3
289	Waiau Pa ..	Clay loam ..	0	2	1	3
311	Ramarama ..	,, ..	½	2	1	3
389	Kaipaki ..	Loamy peat ..	0	3	0	3
261	Tauranga ..	Sandy loam ..	1½	2½	2	3½
203	Matamata ..	,, ..	2	4	3	3½
147	Waimauku ..	Silt	1½	3	2	5
220	Orewa ..	Sand	1	3½	1	3½
432	Ruatangata ..	Loam	2	2	3	4½
383	Kerikeri ..	,, ...	½	2	2½	2½
328	Te Kuiti ..	Sandy loam ..	½	2	1	2½
239	Te Kowahi ..	,, ..	½	2	1	3
342	Rukuhia ..	,, ..	½	2	1	2½
376	Ngahinepouri ..	Coarse sandy loam ..	½	2	1	2½
131	Runciman ..	Loam	1½	2	3½	5
127	Waiuku ..	,, ...	3½	4	4½	5

THANKS.

Thanks are due to Mr. P. W. Smallfield, Fields Superintendent, Auckland, and to Mr. J. W. Woodcock, Crop Experimentalist, Wellington, for their very helpful criticism of this article.

In accordance with the provisions of section 7 (2) of the Noxious Weeds Amendment Act, 1934, the Franklin County Council has assumed the administration of the Noxious Weeds Act, 1928, and its Amendments.

SPRAY SCHEDULE FOR CONTROL OF PRINCIPAL ORCHARD DISEASES AND PESTS.

W. K. DALLAS, Horticultural Division, Department of Agriculture.

INCREASED and more intensified research is being conducted into the problems of disease and pest control in all countries of the world, including this Dominion. The Department is keeping closely in touch with the results which are being obtained from the comprehensive trials which are being carried out here and overseas with a view to further improving the spray schedule.

For the sake of clarity, in the following statement the treatment recommended for the principal pests and diseases will be dealt with in groups as far as practicable.

CHEWING INSECTS.

For such chewing insects as codling moth, leaf-roller caterpillar, pear or cherry slug, and bronze beetle, lead arsenate at a dilution of 1½ lb. to each 100 gallons water is recommended at the following periods :—

Period of Treatment.	Codling Moth.	Leaf-roller Caterpillar.	Pear or Cherry Slug.	Bronze Beetle.
About 1st November	Petal-fall—75 per cent. petals fallen	Petal-fall	When slug makes its appearance	Petal-fall.
About 10th November	10 days later	10 days later	Repeat if necessary 14–21 days later	10 days later.
About 28th November	14 – 18 days later	14 – 18 days later	..	14 – 18 days later.
About 16th December	Ditto ..	Ditto ..	..	Ditto.
About 4th January ..	14 – 21 days later	14 – 21 days later	..	..
About 25th January	Ditto ..	Ditto ..	..	..
	Continue on mid-season and late varieties in localities where late infection may be expected	Ditto ..	..	..
About end February	..	Ditto ..	..	..

For the satisfactory control of leaf-roller caterpillar the sprays require to be continued later into the season than it is customary to apply them. In localities where the caterpillar appears earlier than petal-fall spray at its first appearance. The foregoing programme has been compiled with a view to ensuring that an adequate coverage is maintained upon the fruit and foliage. It is the practice in some Nelson orchards to make as few as four applications of lead arsenate in the season.

The following analysis of results obtained in official experiments carried out in the Hawke's Bay District and at the Nelson research orchard indicates the value of spraying with lead arsenate 1½ lb. per 100 gallons spray for the control of codling moth, leaf-roller caterpillar, and bronze beetle :—

District.	Lead Arsenate : Number of Applications.	Wormy Apples.	Stings.	Leaf-roller.	Bronze Beetle.	Variety.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	
Hastings ..	Check, Nil ..	16·9	1·4	14·9	8·5	Cox's.
	Test, 6 ..	0·6	7·6	0·3	Nil	
Nelson ..	Check, Nil ..	5·5	9·9	41·0	No record	Sturmer.
	Test, 5 ..	0·05	0·8	2·6		

In the Hastings trial 2 gallons spray applied per tree. In the Nelson trial 2¼ gallons spray applied per tree.

Codling Moth is not difficult to keep under control where standard measures against it are adopted. Most injury is occasioned by stings or bites.

Bandaging is a valuable supplementary means of capturing the codling grub. Bands should be applied to the trees by the middle of November, and should be removed carefully in the winter so that the grubs lodged against the bark of the tree will not be lost on the ground. Chemically treated bandages should be burnt, while sacking bandages should be carefully examined and all larvæ found therein killed and the bandages replaced not later than mid-November. Rough bark and crevices should be examined for larvæ.

Other means of control are treatment of picking-cases, examination of packing-sheds and equipment for grubs—picking from the tree or gathering without undue delay fruits which have fallen to the ground, and destroying the grubs by feeding fruit to stock, submerging it in water for a day, or destroying it.

As the result of thorough and timely spraying, together with these supplementary measures, codling moth should not prove troublesome to combat.

Leaf-roller Caterpillar.—The moth is usually in flight in November, December, January, and February period, and in some years into March. As the foregoing results show, spraying is effective against this pest on apple-trees. Where severe injury obtains it is probably due to absence of adequate coverage on the young growth and foliage and on the fruit, or to the discontinuing of the arsenate sprays too early.

Bronze Beetle.—In addition to spraying, the land should be cultivated up to the orchard boundary, and, in addition, the soil about the trees should be stirred at "petal-fall" period : this latter measure is important where the beetle is troublesome.

Pear or Cherry Slug.—No trouble is experienced on pears where lead arsenate is applied to control the codling moth. On cherry trees one, but at the most two, applications of lead arsenate will control this pest.

Sucking Insects.

For sucking insects, such as red mite, scales, aphides, apple-leaf hopper, mealy bug, the schedule of spraying recommended is—

Period of Treatment.	Red Mite, Mealy Bug.	Scales.	Aphides.	Apple-leaf Hopper.
Dormant (July) ..	..	..	On stone-fruits: Tar-oil emulsion (1–15)	..
Bud movement (about 10th September)	Winter oil, 3 per cent.	Winter oil, 3 per cent. (San Jose scale, 5 per cent.)	Pip-fruits: Winter oil, 3 per cent. against woolly aphis	..
Early summer ..	Lime-sulphur at appropriate dilutions	Lime-sulphur at appropriate dilutions when crawlers on move	Lime-sulphur at appropriate dilutions (nicotine sulphate 1–800 may be added)	Add nicotine sulphate 1–800 to spray should nymphs appear. Repeat 18–21 days later.
January and February	Summer oil, 1·5 per cent.	Summer oil, 1·5 per cent.	Summer oil, 1 per cent., plus nicotine sulphate (1–800)	Summer oil, 1·5 per cent., plus nicotine sulphate (1–800).
10 days later	Ditto .. .. Repeat if necessary	Ditto .. .. Repeat if necessary	Ditto .. .. Repeat if necessary	Ditto. Repeat if necessary.

Note.—For mealy-bug control nicotine sulphate 1–800 should be added to summer-oil sprays.

It is not advisable to apply oils until at least fourteen days have elapsed preceding or following sulphur or lime-sulphur sprays. If the trees are suffering from drought conditions the effects of applying an oil spray to the fruit will be to accentuate the lack of depth of colour in the fruit. In seasons of normal rainfall oil has the effect of enhancing the colour of the fruit. The application of tar-oil sprays should be confined to the "dormant" period. If this period has passed tar-oil should not be applied.

Red Mite.—This so far has been proved to be one of the most difficult pests to control. If over-wintering eggs are at all prevalent, it is advisable to apply winter oil (preferably quickly breaking emulsion type) at bud-movement. Thorough spraying to cover the whole surface of the tree is essential to success. During early summer lime-sulphur sprays should keep mite reasonably under control. Towards the end of January and early February apply summer oil (1–80), two applications at a ten-day interval. If live mites are still in evidence, apply one further application. Autumn females lay a phenomenal number of over-wintering eggs. If oil sprays are applied at the correct period approximating the time the commencement of laying of over-wintering eggs—which, by the way, varies from season to season—a complete kill can be obtained and no winter oil need be applied in the following spring.

Scales on pip and stone fruits in carefully tended orchards give little trouble.

Aphides.—Tar-oils applied during dormancy have given good results as an ovicide against green-aphis infection on peach-trees in the Alexandra district.

Woolly aphis during the past five to seven years has again become a troublesome pest in the late summer, necessitating the application of sprays to keep it in control due to late appearance in the season of the natural enemy (*Aphelinus mali*).

Apple-leaf Hopper.—This pest is readily controlled if control sprays are applied while the hopper is in the "nymph" stage. If, however, it is neglected and allowed to reach the winged stage it will devitalize the foliage and seriously arrest the growth of the immature fruits. The hopper, where established, makes its appearance at two periods, November–December, and March, which is usually the most severe infection.

Mealy Bug.—This pest is difficult to control, particularly on pear-trees. Winter Nelis variety is particularly susceptible.

Black Spot and Powdery Mildew.

For black spot and powdery mildew the schedule of spraying recommended is—

Period of Treatment.	Spray.
Green-tip (about second week in September)	Bordeaux mixture (5–4–50) or lime-sulphur (1–30).
Tight-cluster	Lime-sulphur (1–75).
Pink	Lime-sulphur (1–150).
Petal-fall (about 1st November)	Lime-sulphur (1–150) plus colloidal sulphur (2–100).
10 days later	Lime-sulphur (1–150) plus colloidal sulphur (2–100).
14–18 days later (about 28th November)	Lime-sulphur (1–150) plus colloidal sulphur (2–100).
14–18 days later	Lime-sulphur (1–150) plus colloidal sulphur (2–100).
14–21 days later (about 4th January	Lime-sulphur (1–180) plus colloidal sulphur (2–100).
14–21 days later	Lime-sulphur (1–180) plus colloidal sulphur (2–100.)
Continue if necessary.	

Note.—Lime-sulphur dilution refers to specific containing 15 per cent. poly-sulphide content, calculated on basis of weight.

Black Spot.—The first five sprays are important in the control of both black spot and powdery mildew. The first and second are particularly important in black-spot control. On varieties susceptible to spray russet, Bordeaux should not be applied later than the green-tip period. To assist in minimizing ascospore infection in localities where black spot is prevalent, it is advisable to plough the land deeply in the autumn to bury the leaves, and to postpone further working of the soil until after petal-fall period. The summer (pepper spot) infection is particularly troublesome in some localities, and should not be neglected. Its appearance follows closely upon periods of increased rain or dews.

The following analysis of results of official experiments carried out in the Nelson research orchard indicates the effectiveness of the base sprays :—

Treatment.	Dates of Application.	Percentage of Fruit affected with Black Spot.
Cox's Orange—		
Check, Nil	..	71·44
Lime-sulphur—		
1–28	29 Sept.	1·58
1–56	12 Oct.	
1–170	23 Oct., 9 Nov., 25 Nov., 28 Dec.	
Dunn's—		
Check, Nil	..	79·21
Lime-sulphur—		
1–28	29 Sept.	3·78
1–56	12 Oct.	
1–170	23 Oct., 9 Nov., 25 Nov., 28 Dec.	
Delicious—		
Check, Nil	..	78·83
Bordeaux 5–4–50 and 3–4–50 ..	29 Sept., 13 Oct. ..	8·83
Bordeaux 5–4–50 and 3–4–50, followed by lime-sulphur 1–170 plus colloidal sulphur 2–100	24 Sept., 13 Oct., 27 Oct., 10 Nov., 27 Nov., 29 Dec.	0·86
Sturmer—		
Check, Nil	..	51·62
Bordeaux 5–4–50 and 3–4–50 ..	25 Sept., 13 Oct. ..	6·19
Bordeaux 5–4–50 and 3–4–50, followed by lime-sulphur 1–170 plus colloidal sulphur (2–100)	29 Sept., 13 Oct., 27 Oct., 10 Nov., 27 Nov., 29 Dec.	0·09

NOTE.—Lime-sulphur in above table refers to a specific containing 19 per cent. polysulphide content, calculated on the basis of weight.

In the Stoke area of the Nelson District blackening of the skin is experienced with Winter Nelis pears to which Bordeaux is applied while the young fruits are forming. It is believed that this trouble is due to Bordeaux injury, as on pears of Winter Nelis where reduced dilutions of Bordeaux are used the blackening is much less severe, and where lime-sulphur is applied the trouble is not in evidence.

The following is a result of treatment of pears for control of scab :—

Result of Treatment for Pear-scab Control on Winter Nelis Pears.

Treatment.	Number of Applications.	Percentage of Fruit affected.	Remarks (Dates of Spray Applications, &c.).
Check	..	58·53	Spring and summer infection.
Bordeaux (5–5–50), (3–5–50), (1½–5–50), (1½–5–50)	4	2·00	8 Sept., 18 Sept., 2 Oct., 16 Oct.
Bordeaux (5–5–50), (1½–5–50), (1½–5–50), (1½–5–50)	4	0·35	8 Sept., 18 Sept., 2 Oct., 16 Oct.
Check	..	90·85	Spring and summer infection.
Lime-sulphur 1 per cent., 0·2 per cent., 0·1 and colloidal sulphur 0·1 and colloidal sulphur 2–100	4	14·33	8 Sept., 18 Sept., 2 Oct., 16 Oct.
Lime-sulphur 0·083 per cent., 0·083 and colloidal sulphur 2–100, 0·083 plus colloidal sulphur 2–100	4	11·87	8 Sept., 18 Sept., 2 Oct., 16 Oct.

Infection on treated plots was mostly summer infection.

Powdery Mildew.—The following results of official experiments carried out in Hawke's Bay and at Alexandra demonstrate the efficacy of the treatment recommended.

The sprays were applied to Jonathan trees on the basis of the foregoing programme with the following results :—

District.	Check Plot.	Treated Plot.
Hawke's Bay ..	No control of powdery mildew. Leaves curled and browned at edges	Very good control. Clean, healthy foliage, which was of a dark-green tone. Foliage remained free of mildew throughout season. Preblossom sprays prevented initial infection.
Alexandra ..	No control. Early part of season moderate infection which as season advanced became heavy on foliage, shoots, and buds	Very good control. Infection was very light on foliage and tips of shoots and spurs. Most infection will be removed at pruning-time.

Similar results were obtained in the trials carried out in the Canterbury District.

Peach Leaf-curl.

For peach leaf-curl the treatment recommended is—

Period of Application.	Treatment.
Autumn or early bud-movement of blossom-buds	Bordeaux 5–4–50.
Early pink	Bordeaux 3–4–50.

Peach leaf-curl may be completely controlled by one spray applied in the autumn or in the spring prior to green-tip of the most advanced leaf-buds. It is all-important to ensure that the spray is applied prior to the leaf-buds reaching the green-tip stage, which is too late to obtain satisfactory control. Care should be taken to see that the laterals, particularly the tips, are sprayed. The results of all our official experiments support the above.

Brown Rot and Leaf Rust.

For brown rot and leaf rust the treatment recommended is—

Period of Application.	Brown Rot.	Leaf Rust.
Early pink	Bordeaux 3–4–50 or lime-sulphur 1–75	..
Pink	Lime-sulphur 1–150 ..	..
Petal-fall	Lime-sulphur 1–180 plus colloidal sulphur 2–100	Lime-sulphur 1–800 plus colloidal sulphur 2–100.
1 month later	Ditto	Ditto.
7 weeks later	,, ...	,,
5 weeks prior to anticipated first picking	,, ...	,,
2 to 3 weeks later ..	,, ...	,,

Notes.—Lime-sulphur refers to a specific containing 15 per cent. of polysulphide content, calculated on the basis of weight.

It is not advisable to apply sulphur sprays to apricot-trees while fruit is upon them.

Brown rot is a rather difficult disease to control, particularly under moist and humid climatic conditions. In such localities the only satisfactory way to overcome the trouble appears to be by way of securing, if possible, more resistant varieties. Under normal conditions, however, much can be done to reduce infection in addition to spraying.

The following are rules of orchard hygiene—elimination of sources of infection: (*a*) Prune out and destroy all diseased twigs and branches at winter pruning and in the spring after blossoming, as these are a means of carrying the disease over to future years. (*b*) Pull off and destroy all "mummies," as they also carry over the infection. (*c*) Pick off all infected fruits during growing and ripening periods, as the fungus works from these into the wood of the trees. (*d*) Gather up and burn all prunings and mummies. (*e*) Cultivate at the "pink" period. Soil missed by the implements should be disturbed by hand implements. Every endeavour should be made to break up all compacted surface soil, particularly about the trees. (*f*) Insects (flies, earwigs, &c.) play a prominent part in the distribution of brown rot during the fruit-ripening period. Clean up all rubbish and litter and deprive them of a breeding-ground and a shelter. (*g*) Prune trees to admit air and sunlight. (*h*) Open up tall, close shelter-belts sufficiently to admit sunlight and a free circulation of air throughout the orchard.

Fruit Thinning.—Thin the fruit so that no two fruits touch each other.

Picking and Packing.—(*a*) Pick fruit carefully, and reject all fruits showing skin punctures and bruises. (*b*) Great care should be taken to prevent infected fruits being sent into the packing-shed. (*c*) In the orchard infected fruits should not be dropped on the ground, but put in a tin for the purpose containing sufficient liquid (lime-sulphur 1–180) to cover the fruits to prevent the spores escaping. Bury the ocntents of the tin to a depth of at least 2 ft. (*d*) Pick into boxes or tins in preference to using the picking-bag, which is not recommended for stone-fruit harvesting. (*e*) Second-hand cases and trays should be sterilized. (*f*) Picking-tins should be sterilized daily. Immerse for a minute in boiling water, lime-sulphur solution (1–50), formalin solution (1–40), or bluestone solution (1–100). Do not treat tins with bluestone solution, as they will corrode. Cases must be dried before fruit is packed in them. (*g*) Clean and sterilize grading-tables thoroughly after each day's work. This should not be neglected. (*h*) To minimize chances of infecting sound fruits while they are being picked and packed, those handling diseased fruits should be careful to clean their hands before (*j*) After packing, stack fruit in such a manner so that an air current handling sound fruits again. (*i*) Allow fruit to stand in a cool place. may pass between the cases so as to allow of the heat given off by the fruit to quickly escape.

Treatment for Silver-leaf (Stereum purpureum).

The fungus penetrates trees through wounds formed during pruning or ploughing, or through broken branches. It lives over from season to season on infected fruit-trees, silver birch, poplar, willow, and broom, and produces its fructifications on dead branches of these hosts. From

these, spores are spread which are capable of infecting wounds and reproducing the disease in healthy trees in the vicinity. Consequently to combat the disease it is necessary to—

(1) Remove and burn infected branches, preferably during the early summer, cutting well below the visible point of infection. Cut stubs and broken branches as close to the main branches as possible, and dress and smooth with a sharp knife so that the wounds may callus over rapidly.

(2) Cover all wounded surfaces as soon as made with a protective cover, such as bitumen paint, coal-tar, or white-lead paint.

Citrus Troubles.

In the control of diseases and pests of citrus-trees the recommendation is—

Period of Treatment.	Verrucosis, Grey-scab.	Scales.		Thrips.
		Brown.	Red and White Wax.	
Opening of earliest blossoms (October)	Bordeaux (3–4–50)	..	..	..
Blossom-fall of main crop (November)	Bordeaux (3–4–50)	..	..	Nicotine sulphate 1–800. Combine with bordeaux spray.
During December–January	..	Summer oil (1–60)	Summer oil (1–33)*	..
During late February	..	..	Ditto ..	Summer oil (1–60) plus nicotine sulphate (1–800).
Towards end March	..	..	,, ..	Repeat when necessary.
Blossom-fall of autumn crop (March–April)	Bordeaux (3–4–50)	..	..	Ditto.
During mid-April ..	..	..	Summer oil (1–33) if necessary	,,

* This application recommended for certain years when young red scales are hatching freely at this period.

Leaf-roller Caterpillar.—Apply lead arsenate $1\frac{1}{2}$–100 when infection is anticipated, and repeat at three-weekly intervals.

Thrips.—If summer oils have not been applied to the trees, lime sulphur (1–40) may be used for the control of thrips at the times specified in the above schedule.

Bark-blotch.—Remove infected tissues around the cankers. Treat the wounds with either—(1) Bordeaux paste or (2) swab wounds with solution acidulated mercuric chloride, and, when dry, paint wounds with a protective covering such as bitumen paint, coal-tar, or white-lead paint.

Brown Rot.—For the control of this disease growers are recommended to remove all branches within 3 ft. of the ground, and to stir the soil during the summer months beneath the trees sufficiently frequently to maintain a layer of dry soil about 3 in. in depth. In the autumn allow volunteer growth of herbage to grow or sow cover crop.

Sprays are most effective against scales while this pest is in the "crawler" stage. The emergence may commence as early as December.

It is inadvisable to apply oils to citrus trees later than the end of April and to apply " winter " oils to the trees.

Russet on Apples.

Russet is a matter of serious concern to apple-growers on account of the depreciation it causes to the appearance of the fruits. As tree impoverishment greatly influences russeting, it may be considerably reduced by giving the orchard good care and maintaining the trees in a vigorous, healthy condition. Much investigational work has already been done, and workers are still endeavouring to discover a method of reducing the amount of this type of blemish. It is not an easy problem to solve, on account of the number of factors involved. Briefly, the principal factors which, either singly or a combination of two or more, influence russeting are—(1) Unthrifty condition of trees due to various causes. Fruit produced on vigorous trees is less susceptible to russet: (2) Unsuitable climatic conditions, including wind, frost, &c.: (3) Unsuitable soil conditions: (4) Disease (powdery mildew): (5) Spraying: (*a*) Application of sprays which are too caustic to newly-formed fruits; (*b*) Application of sprays in excess volume; (*c*) Retention of sprays in liquid condition on the surface of fruits for indefinite periods. (Late evening applications under high relative humidity are very liable to cause russeting); (*d*) Sprays containing gritty materials.

The sprays in common use which cause russet on apples are—(1) Bordeaux mixture when applied to certain varieties such as Sturmer Pippin later than the " green-tip " period. On other varieties this spray may be applied as late as the " tight-cluster " period with safety: (2) Strong lime-sulphur sprays: (3) Lime-sulphur - lead-arsenate combination is a source of much injury if incorrectly prepared.

To reduce spray injury—(1) Prepare the mixture as follows: Lime sulphur and lead arsenate.—Fill the tank with water, and to this add the required volume of lime-sulphur. To the required quantity of lead arsenate add three times its weight of hydrated lime, mix with water to form a thin paste, and pour it into the spray-tank while the agitator is running. Apply as rapidly as possible after mixing. It is advisable to confine the quantity of the respective mixings to such quantity as may be discharged within one hour: (2) Prepare sprays carefully: (3) Cover trees thoroughly with a film of spray, but do not overspray them: (4) Care and judgment should be used in applying this combination spray. Avoid as far as practicable applying lime-sulphur-lead-arsenate combination spray when the surface of the fruit is liable to remain wet with spray for several hours. Also care should be used in applying this spray during periods when high temperature and high relative humidity prevail: (5) In localities exposed to winds off the sea, as long a period as possible following such winds should be allowed to elapse before a sulphur spray is applied, on account of the saline deposit which these winds leave on fruit and foliage.

In conclusion the following points are important:—

(1) While the schedules given are designed to cover seasons of maximum infection of diseases and pests, it is important that growers should bear in mind that under different climatic conditions the times of sprayings and the number of sprayings and dilutions may require to be varied to some extent to meet local seasonal conditions. For advice on such matters growers are advised to interview the Orchard Instructor for the district, who will be pleased to give full information.

(2) While orchard sanitation (elimination of sources of infection) will in itself not completely eradicate diseases and pests, it should be practised in every orchard. The following measures are recommended: (*a*) Clean up and destroy all rubbish and litter in and about the orchard, as they provide a breeding-ground and shelter for diseases and pests. (*b*) Prune out from time to time as it appears, and destroy dead and dying wood. (*c*) Gather and destroy diseased fruits and mummies, windfalls and dropped fruit, and cull fruit without undue delay. (*d*) Cultivate the soil at appropriate periods calculated to prevent the development and dissemination of spores from organisms carried over in the soil. (*e*) Prune trees sufficiently so as to admit sunlight. (*f*) Thin the fruits judicially. (*g*) Reduce in height and open up tall and close shelter-belts in order to admit sunlight and a free circulation of air throughout the orchard. (*h*) Bandage trees to trap codling moth larvæ, and examine crevices in bark for larvæ. Remove any rough bark which may be present. (*i*) During picking and packing take every care and precaution to avoid infection of sound fruits with fungous diseases.

(3) Thoroughness of application is very advisable. Special attention should be given to the inside as well as the outside of the tree, and to the tops and bottoms as well as the middle portions of the tree to ensure that all fruits receive a complete coating of spray. Careful spraying is necessary to receive maximum protection and to avoid over-spraying and spending more time than is necessary. To insufficiently spray trees is both a waste of materials and time. This fault is much more common than it should be, and growers who fail in this respect are ready to blame the materials, the dilution, the schedule, the season, and the advice given for their failure to control diseases and pests. A study of the reports of Instructors conducting spraying experiments indicates that it takes approximately 3 gallons of spray to cover adequately an average-sized tree in foliage, while larger trees require increased quantities according to the size and density of foliage. The pump should be capable of delivering 3 gallons per minute at a pump pressure of upward of 250 lb. to the square inch. A spray-rod fitted with an angle nozzle or two in combination should be used in preference to a spray-gun, particularly for the "calyx" spray and for spraying the bottoms of the trees. Spraying followed by rain within twenty-four hours should be repeated.

(4) Timeliness of application contributes greatly to success. To the neglect of this can be traced the failure of many orchardists to control diseases. Orchardists whose results from spraying are not satisfactory are invited to discuss their schedule with the local Instructor, with a view to the modification of the times at which it is proposed to apply sprays, dilutions, &c., to meet the local requirements.

(5) Use of tried specifics is advisable. There is a distinct trend on the part of overseas manufacturers to bring forward numerous new brands of orchard sprays or spraying-materials. These should be regarded with caution until their efficacy has been demonstrated.

(6) Want of care does more harm than want of knowledge. In other words, better crops are not obtained because sufficient care is not given to cultivation, manuring, orchard hygiene, application of sprays, thinning, &c. The amount of harm this lack of care does will never be realized until the necessary attention is given to carrying out orchard practices properly.

SUBTERRANEAN CLOVER IN THE NORTH ISLAND.

C. J. HAMBLYN, Acting Fields Superintendent, Palmerston North.

AT the 1936 conference of the New Zealand Grassland Association a group of four papers on subterranean clover was read by field officers of the Department of Agriculture, giving the experience with this clover as a pasture species in North Auckland and South Auckland (excluding the King-country, the pumice lands of the central plateau, and Bay of Plenty), Manawatu and west coast, and Hawke's Bay. During the subsequent discussion of the papers the position in Taranaki, Wairarapa, Poverty Bay, Bay of Plenty, and other parts of the Auckland Province, including the pumice country round Rotorua and Taupo, was indicated. It is the intention in this article to summarize the present position and possibilities of subterranean clover in the North Island as disclosed by the papers and the discussion.

GENERAL CHARACTERISTICS.

Subterranean clover is a strongly growing and very palatable annual clover, which buries its seed in the surface soil, ensuring its permanence when once established in a sward. The seeds germinate with the autumn rains, and the plant grows and develops through the autumn and winter and comes away earlier than most pasture species in the spring, giving its maximum growth in the North Island from August to November. Flowering takes place during the period of maximum growth, and the plant dies off with the approach of hot, dry, summer weather. The seed which is buried as the plant develops lies dormant in the soil until the autumn rains come. An essential condition to free re-establishment is the opening-up of the sward to some extent through the summer, while essential conditions to good early spring production are early autumn establishment, freedom from water-logging in the winter, moisture and warmth in the spring, and, above all, adequate phosphatic manuring. As with all pasture-plants, the more fertile the soil the higher the production, but subterranean clover has a surprisingly wide range in regard to soils, and, with adequate phosphate supplies, will easily outyield all other annual clovers on most second- and third-class land.

RECENT WIDESPREAD INTEREST IN SUBTERRANEAN CLOVER.

Though subterranean clover has been known in certain districts of the North Island for the past fifty years, particularly as Mangare clover on the volcanic soils near Auckland and on similar soils in the vicinity of Whangarei, it is only in recent years, following its wider use and extensive propaganda in Australia, that a similar realization of its possibilities in this country has developed. While in the past subterranean clover has been mainly confined to dairy pastures and high-rainfall areas, it is in connection with sheep-farming and in districts of lower rainfall and dry summers that present interest is chiefly centred.

Experience in Various Districts.

NORTH AUCKLAND(1).

Subterranean clover has long been appreciated as a valuable clover in dairy pastures on free-draining volcanic soils. Its tendency to smother other species under light stocking and the prevalence of bloat in cattle in favourable seasons have been regarded as bad faults, but under good management and utilization it has shown clearly its capacity for high spring production. The fact that rye-grass, white clover, and paspalum can combine well with subterranean clover under good management is now generally recognized, and this clover is accepted as a useful additional species. It is, however, on the older, consolidated, sand-dune country of the west coast too dry in summer to hold white clover, and where its superiority over *Lotus hispidus* and suckling clover, the main legumes of the pasture, is very marked, that its use should be developed. On sandy gum land also there is considerable scope for the extension of subterranean clover. The main requirement in both cases is adequate phosphatic manuring which the introduction of subterranean clover would make profitable on swards at present not capable of giving satisfactory returns for top-dressing.

As in many other districts, it is in connection with fat-lamb production that the use of subterranean clover is likely to prove most profitable in North Auckland. Much of the rolling sandstone and greywacke hill country at present carrying dry stock and not worth top-dressing could, with the introduction of subterranean clover and phosphatic manuring, be converted into fat-lamb pastures.

SOUTH AUCKLAND(2).

The area covered in this paper extends from Auckland south to the Waikato. Subterranean clover has been recognized for many years in the Manakau and Franklin Counties as a valuable clover additional to white clover, particularly on account of its ability to re-establish quickly after occasional dry summers, when white clover may be practically killed out. Because of the usual adequate summer rainfall of South Auckland dairying lands, white-clover establishment is, however, generally the aim on most dairy farms. Subterranean clover is appreciated on the volcanic lands and lighter pumice soils for its early and heavy feed-production and the excellent silage it makes. As in North Auckland, there is likely to be a considerable extension of the use of subterranean clover for fat-lamb production, particularly on the lighter volcanic, sandstone, and pumice soils, when its value in this direction is more fully appreciated.

MANAWATU AND WEST COAST(3).

In this area, extending from Paraparaumu to Wanganui and from the west coast to the mountain ranges, the value and possibilities of subterranean clover on different types of country have been well demonstrated by changes effected in the production of farms since its introduction. The reason for the increase in the quantity of subterranean-clover seed sown in the Manawatu district from a few pounds five years ago to 12 tons in 1936 is quite apparent when the scope for the use of subterranean clover is realized.

On the coastal belt of consolidated sands, with a rainfall of 35 in., the introduction of subterranean clover to certain farms has been the means of converting poor dry-stock country to dairying and fattening land at a much lower cost and much more rapidly and satisfactorily than was the case where the usual methods of attempting the establishment of rye-grass and white clover have been used. With the ordinary pasture species sown on the best of the consolidated sandy flats, the tendency to reversion to sweet vernal and *Poa pratensis* is very marked. The establishment of subterranean clover, with less than the usual phosphatic top-dressing, has given a rapid increase in production and a steady improvement in the sward. Subterranean clover, sown with the grass-mixture on the richer flats after a root crop or rape, drilled into the existing swards on the poorer flats, and broadcast on the sandy ridges, is paving the way to profitable top-dressing and the successful establishment of such species as perennial rye-grass and white clover. Changes from one dry sheep to three and four ewes per acre or a cow to 2 acres are being made through subterranean clover. It is very apparent that the limit of carrying-capacity on this country has not been reached, since lucerne and paspalum, both of which thrive well, are being gradually exploited to provide additional summer feed to carry on when the subterranean clover goes off. There is also in the district a considerable area of light friable loam characterized by a marked tendency to reversion to brown-top and danthonia. Subterranean clover on this country is also giving remarkable results. Dry-sheep country sown with 2 lb. to 4 lb. of subterranean clover and top-dressed with 1½ cwt. to 2 cwt. of superphosphate is being changed rapidly so as to be able to carry three to four and more ewes per acre, with the lambs going off fat earlier than is usual on the heavier land. From Palmerston North through Feilding, north to Marton and beyond, there is a wide stretch of heavier, flat, undulating country with bad natural drainage, and a tendency to rushes and brown-top. Individual farmers in this area have demonstrated the value of subterranean clover, either broadcast on the existing sward or sown with a grass-seed mixture, in rapidly increasing the carrying-capacity of this land both drained and undrained.

The light sandy coastal belt, the friable clay loams, including much of the lower foot-hill country along the ranges, and the heavier rolling clay lands of this portion of the Wellington Province represent some 350,000 acres, and it is safe to say that the exploitation of subterranean clover by farmers on this area would mean at least doubling the carrying-capacity.

HAWKE'S BAY(4).

It is undoubtedly in Hawke's Bay, with its occasional very dry summers and vast areas of light freely draining soils extending from Woodville through Norsewood, Takapau, Maraekakaho, to Tutira, Putorino, and Mohaka up to the Wairoa flats and beyond, that subterranean clover has especially demonstrated its wonderful potentialities as a valuable pasture species. Right through this belt of country, estimated at upwards of 500,000 acres, the introduction of subterranean clover, whether it be by inclusion in the seed-mixture after ploughing, by surface-sowing with top-dressing after severe harrowing of the existing sward, or by surface-sowing with fertilizer on open danthonia

or brown-top turf, has resulted in a very definite increase in carrying-capacity. The response of the subterranean clover to superphosphate has been remarkable, and the ability of this clover to produce feed for lamb-fattening just when required is appreciated. The doubt as to whether top-dressing pays on much of the rolling to steep hill country has been removed by the introduction of subterranean clover, and in Hawke's Bay, as in Manawatu, Wairarapa, and Poverty Bay districts, some outstanding increases in carrying-capacity have been recorded. Other country suitable to the exploitation of subterranean clover in Hawke's Bay are the Takapau Plains, the lighter soils of the Hawke's Bay flats, much of the limestone country which has shown reversion, and the extensive area of coastal and southern hill country. It is indeed difficult to visualize the result of the full exploitation of subterranean clover in the province. The quantity of seed being sown is rapidly increasing. Last season some 30 tons was used, sufficient at 4 lb. per acre to sow over 15,000 acres.

The fact that when fully utilized it gives its greatest returns, that set-stocking with ewes and lambs is a relatively simple matter when once the carrying-capacity is gauged, and, further, that subterranean clover well utilized is helping to bring back rye-grass and white clover, are points which are likely to bring about a rapid extension of the area sown to this clover. On some of the lightest pumice country in the district increases from one dry sheep to the acre to five and six ewes with all lambs away fat are recorded.

WAIRARAPA AND POVERTY BAY.

In both these districts large quantities of subterranean-clover seed are being sown, the quantity increasing rapidly each year. In the Wairarapa, subterranean clover is being used with excellent results on the lighter shingly soils of the plains, and is having a very marked effect on the carrying-capacity both for dairying and sheep-farming. Recorded experience has shown that much of the rolling hill country, especially the coastal belt, could be rapidly and profitably improved by subterranean clover, which allows so definitely for the profitable use of top-dressing on swards that probably do not pay for manure. In the same way in Poverty Bay, subterranean clover is destined to play an important part in the regeneration of much of the hill country. Many farmers are now exploiting subterranean clover, and it is evident that this clover is likely to overcome the difficulty of the relatively high cost of top-dressing in this district.

Information from Discussion of Papers.

It appears from the discussion at the conference of the New Zealand Grassland Association that in the North Island on all the lighter soil types subject to drying out in the summer, subterranean clover can be used to advantage. Its ability to give rapid and effective response to phosphatic manuring and the subsequent improvement in the conditions for rye-grass and white clover through heavier stocking are the main contributing factors to its success. The Bay of Plenty, with its extensive areas of light soils and dry summers, should find in subterranean clover a valuable pasture species likely to outyield the suckling clover and *Lotus hispidus* prevalent on much of this country.

In the King-country, the Waikato, Rotorua, and Taranaki the satisfactory reseeding of subterranean clover may be hindered from time to time by the closeness of the sward in January and February in seasons of good summer rainfall. In the Waikato and the coastal areas of Taranaki, however, subterranean clover is proving a valuable additional clover, and on the poorer soils in these districts, if fully exploited, is capable of improving the fertility up to rye-grass and white-clover requirements.

A discussion of the altitude range of subterranean clover showed that it was being successfully grown at an altitude up to 2,000 ft. in the Raetihi and Poverty Bay districts, and it is evident that the possibilities in the central tableland to the south of Taupo are well worth investigation. While considerable detail was available at the conference as to methods of establishment and utilization under widely varying conditions, such information is best obtained from the officers of the Department of Agriculture in the districts covered by this review.

Position of Subterranean Clover in North Island reviewed.

Reviewing the position in regard to subterranean clover in the North Island in the light of the papers read at the conference and the discussion on them the main points can be summarized as follows:—

(1) In the Wairarapa, Manawatu, Wanganui, Hawke's Bay, and Poverty Bay districts an area estimated at upwards of 1,500,000 acres of grassland could be converted rapidly and economically from dry-stock to fattening land by the use of subterranean clover and phosphatic manuring. In the Auckland, Taranaki, and Bay of Plenty districts, while the value of subterranean clover in fat-lamb production has not been tried out to the same extent as in the southern half of the Island, and the soil and rainfall conditions generally are not so well suited to subterranean clover, there are indications that this clover could well replace inferior annuals such as suckling and *Lotus hispidus* on considerable areas of second- and third-class country, particularly where the returns from top-dressing are doubtful.

(2) The seasonal production from subterranean clover coincides exceptionally well with the seasonal requirements of the ewe and lamb, and set-stocking in the spring to the limit of what the paddocks will carry is the best method of utilization. The clover re-establishes well, when once thick enough to form a sward, under heavy stocking.

(3) Phosphatic manuring is essential to subterranean clover on poor soils. Lime is not nearly so important as it is with white clover, and can be used as a forerunner to good rye-grass and white clover Subterranean clover, therefore, responds well to superphosphate, and lime is required only in exceptional circumstances.

(4) Subterranean clover fully utilized is a valuable soil-improver, establishment, with which it combines well when adequately stocked.

References.

(1) Paper read by E. B. Glanville at 1936 Grassland Conference.
(2) Paper read by J. Bell at 1936 Grassland Conference.
(3) Paper read by A. J. Galpin at 1936 Grassland Conference.
(4) Paper read by J. W. Palmer at 1936 Grassland Conference.

GERMINATION OF "NEW SEASON'S" ALGERIAN OATS.

E. O. C. HYDE, Seed-testing Station, Palmerston North.

GENERALLY farmers are aware that the sowing of "new season's" oats in the autumn is attended by the risk of poor germination. This danger is often avoided by sowing at a heavy rate, or by using "old season's" seed. Nevertheless, the difficulty of judging the suitability of seed for autumn sowing not infrequently results in considerable loss. The trouble arises from the fact that the oat grain generally requires several months for its complete after-ripening.

It is characteristic of the seeds of many plants that they are incapable of germinating when newly ripened, or can be brought to germinate promptly only by the application of some special stimulus. During storage changes take place which render these "dormant" seeds capable of prompt germination. In this connection we speak of the process of "after-ripening," although the nature of the changes involved is still largely a matter of conjecture.

The oat grain for some weeks or months after harvesting is in a "dormant" state, and only gradually, with the progress of after-ripening, acquires its full germinating-capacity. Dormant oats germinate, however, if they are first placed for about six days under moist conditions at a temperature within a few degrees of freezing-point. Thereafter they will continue to grow in a normal manner at higher temperatures. Under warm conditions (20° to 30° C.) dormant oats germinate completely only after the lapse of months. Furthermore, after a period of several days under these warm, moist conditions the seed loses its capacity to respond to the stimulus of low temperatures. Fully after-ripened oats, on the other hand, germinate within a wide range of temperature, from near freezing-point to as high as 30° C., the optimum temperature being about 20° C.

As regards germination, the behaviour of newly harvested oats is the same in the field as in the laboratory at temperatures comparable with the soil temperatures. There are ample grounds for the belief that soil temperature is generally the limiting factor in determining the rate of germination of dormant or partially dormant oats in the field.

The temperature of the soil, near the surface, varies widely at all seasons, but in the fine weather which prevails during the autumn months it frequently rises (in tilled ground) to over 30° C., while the minimum night temperature may be as high as 20° C. A comparison of the germination of a number of samples of partially dormant oats in the field and in the laboratory showed that during the autumn months there is close agreement between the percentage germination in the field and the percentage in the laboratory with temperature fluctuating daily between 20° C. and 30° C. The Seed-testing Station has now adopted the practice of making two tests of each sample of oats received during the summer

and autumn. In one test the grain is pre-chilled, whereby all dormant seeds are induced to germinate. From this test we learn the proportion of living seeds, and the probable future germinating-capacity in the field when after-ripening is completed or when the prevailing soil temperature is low. The second test is made with the temperature at 30° C. during the day and at 20° C. at night. This test gives the approximate rate of germination which can be expected in the field if the seed is sown immediately.

In this way the difficulties attending the selection of seed can be overcome. There remain, however, problems relating to the supply of seed.

The time occupied by after-ripening varies from crop to crop, and the average duration of the process varies from season to season. Although it was known that after-ripening proceeds slowly after a cool and rainy summer, it has been impossible to foretell when any crop of oats would become suitable for use as seed.

Several investigators have observed that oats, like other cereals, can be "artificially after-ripened" by prolonged kiln-drying. Some preliminary studies have been made at the Seed-testing Station with a view to exploring the possibilities of hastening after-ripening in the grain-store.

Experiments designed to show the separate effects of temperature and moisture content were productive of the following information: The reduction of the moisture content has no immediate effect on the germinating-capacity. Both moisture content and temperature influence the rate of after-ripening, but temperature is the more potent factor. After-ripening is greatly delayed by storage at low temperatures, and is hastened by storage at relatively high temperatures. When stored at 30° C. samples of oats having a wide range of moisture content were all completely after-ripened within twenty-four days. By maintaining the storage temperature at about 30° C. it appears to be possible, at little cost, to have oats ready for sowing within four weeks after threshing from the stook. Prolonged storage at this temperature is injurious to the vitality of the grain, unless the moisture content is low. However, oats with a moisture content as high as 17·6 per cent. showed a decline in germinating-capacity only after storage for two months at 30° C.

The necessity for forcing the after-ripening of oats may seldom arise. It may more frequently be of assistance to grain-merchants to be able to foretell when a given lot of oats will become available for use as seed. Probably when more experience has been gained it will be possible to accomplish this. By determining the germinating-capacity and the moisture content of a sample of the grain, and also the prevailing temperature of the store, it probably will be possible to make some estimation of the time required for the completion of after-ripening.

The Fields Superintendent, Christchurch, reports: A North Canterbury farmer sowed an area of lucerne in February, 1934; one portion was manured with superphosphate, a second portion with Nauru phosphate, and a third with reverted superphosphate, each being applied at the rate of 1¼ cwt. an acre on limed land. The growth on the portion dressed with superphosphate was well ahead of the others in April, and the effect of the reverted superphosphate was no better than that of Nauru phosphate.

NOTE ON THE CARE OF WEANER AND YEARLING HEIFERS.

D. MARSHALL, Veterinarian, Department of Agriculture, Hamilton.

CONSIDERABLE mortality occurred in this class of stock during the winter of 1936, and much of the loss was directly or indirectly due to internal parasites, chiefly stomach-worm, though lung-worm was troublesome in some instances. In South Auckland the summer was wet, and this favoured the survival of a large percentage of the parasites during the period passed in the larval stages outside the host. Further, the sloppy pasture-growth during a wet season itself predisposes to a loose state of the bowels, and seems to be less suitable for young animals than the feed available in a drier season.

There is an intricate relationship between the type of food and the presence of parasites in producing the characteristic unthriftiness, debility, anæmia, and scouring usually (and in most cases rightly) put down to worms. It is not always easy to know just how much of the trouble is due to type of feed in itself and how much to the presence of parasites.

In some instances a single treatment with a reliable worm-drench checks mortality and is followed by improvement in the remainder. At other times repeated drenching seems of little benefit unless aided by better feeding. The Rowett Institute has shown that with young sheep some supplementary feeding greatly reduces the number of parasites that becomes established in the sheep. In Australia Clunies Ross has shown much the same thing, and states that, in combating some of the small worms resistant to drenching, most benefit comes from improving the feed. With young cattle, observant feeders in this country have remarked on the importance of improving the feeding of worm-infested heifers by crushed oats, bran, and linseed-meal, and even by putting the young animals back on a ration of milk.

Routine drenching of young sheep is accepted as a necessity on many sheep-farms. The same conditions apply in young cattle. Parasitic disease is one of the penalties to be paid for permanent pastures and heavy stocking, and must be guarded against. Drenching of young stock once mortality has commenced is sometimes disappointing in its results. Among the several reasons for this are—(*a*) Treatment is not begun until all animals are already in an anæmic state and have lost condition; (*b*) insufficient attention is paid to supplementing the action of the drench by some improvement in feeding (complete elimination of worms, even if it were possible, would still leave the animal in an anæmic, weakly state calling for nursing and tonics); (*c*) animals are returned to the same pastures and reinfection is constantly taking place.

The symptoms of parasitic gastritis are unthriftiness, harsh coat, and a "skinny" appearance, weakness, anæmia indicated by pallor of lining of eyelids, &c., and nearly always some degree of scouring. Somewhat similar symptoms are seen in "bush-sick" cattle, but scouring is not a feature.

Indications at present point to the coming summer being favourable to the development of parasitic disease, and in view of the increase in value of dairy yearlings additional care is justified to bring them

through their first and most critical winter. If there is a choice between dry, sunny faces and damp flats the former should be chosen as a grazing-area for yearlings. Heavily top-dressed pastures are not ideal, but a newly-sown paddock, being clean, should be suitable, if the feed is not too laxative. Ample range is always desirable, but on smaller dairy-farms may not be available.

Where suitable grazing-areas are not available, and particularly where parasitic gastritis has been in evidence in the past, drenching should be commenced not later than the 1st of March, and repeated at least once a month. In this way parasites are kept in check, and it is easier to maintain condition on such animals than to try to replace it in ones enfeebled and anæmic through parasites.

A suitable worm-remedy is the bluestone and nicotine used for sheep. If this is mixed at the rate of 2 oz. bluestone and 2 oz. of 40-per-cent. nicotine sulphate to 1 gallon of water, six-to-eight-months calves may be given 4 oz., increasing gradually to 6 oz. at a year old. It may be found that a few yearlings will be made staggery and will go down, but these will recover in a few minutes. If this happens the amount of drench may be slightly reduced. No preliminary fasting is necessary, but it is desirable to yard the animals for two hours beforehand and to keep them from water for one hour after drenching.

In addition to routine drenching, feeding must be adequate. Good hay should be available from the end of April. A small amount of concentrated food such as crushed oats, and bran, with a little linseed-meal, or meat-meal will be helpful in July, usually the hardest month.

Shelter is highly important: an open-fronted shed, or access to a good haystack, will at least give warmer sleeping-quarters if good hedges are not available. In ridgy country the lie of the ground may give a certain amount of shelter from prevailing winds.

No mention is here made of treatment of lung-worms, but the same general control measures are beneficial in combating these. Drenching, while of almost no value against lung-worm, should not be neglected, as very often, though lung-worms are present and the frequent cough due to them is in evidence, the stomach-worms are the real offenders.

GOVERNMENT OFFICIAL HERD-TESTING OF PUREBRED DAIRY COWS.

SUMMARY OF THE 1935–36 SEASON'S WORK.

W. M. Singleton, Director of the Dairy Division, Wellington.

The Government Official Herd-testing has now been in operation for nine years, the present summary covering the year ending 30th September, 1936. Since the inception of the system 16,701 statements of seasonal production have been issued, representing an average of 1,855 cows per year. During the past season 1,910 cows were tested, a decrease of 148 cows from the 1934–35 total of 2,058. The cows tested during the season under review were in the herds of 183 breeders, as compared with 195 herds for the

previous season. The maximum number of Certificate-of-Record breeders with cows on test during the same period was 237, so that over 75 per cent. took advantage of the Government official herd-testing system.

Average butterfat production per cow showed an increase of 16·28 lb., the 1935–36 average being 326·32 lb. fat, as compared with 310·04 lb. for the previous season. The statistics appearing in this review are based on all cows on test for six months (180 days) or more. The Government Official Herd-test is a ten-months test. Cows other than registered purebreds are omitted from the tables, although a small number are tested each year by special arrangement. The number of cows tested under this heading during the period under review was thirty-two, as compared with thirty-one for the previous season. Registered purebred cows totalling 125 were on test for less than 180 days, and are therefore not included in the summary tables.

The following figures provide a comparison of average butterfat production for the various systems of testing in the Dominion: New Zealand's average herd-test cow for the 1935–36 season, including all cows in milk 100 days or more, yielded 257·64 lb. butterfat in 258 days. The Government Official Herd-test average on the same basis was 322·19 lb. in 283 days, while the Certificate-of-Record 305-day test average was 417·76 lb., and the Certificate-of-Record 365-day test 516·30 lb.

Table 1.—Official Herd-testing in Two Past Seasons on Basis of all Cows on Test for 180 Days or More.

Breed.	Number of Breeders.	Number of Cows.	Average Yield for Season.		
			Days.	Milk.	Butterfat.
		Season 1934–35.		Lb.	Lb.
Jersey	151	1,368	287	5,955·7	320·85
Friesian	20	285	284	8,271·6	295·19
Milking Shorthorn	7	182	276	6,332·9	264·69
Ayrshire	2	31	292	6,708·2	266·06
Red Poll	1	4	234	3,324·3	134·44
Guernsey	1	6	300	5,079·6	271·26
Shorthorn	Not represented.				
Totals and averages	178*	1,876	285	6,348·2	310·04
		Season 1935–36.			
Jersey	160	1,350	272	5,765·7	315·72
Friesian	16	392	275	8,402·6	299·19
Milking Shorthorn	6	108	277	7,477·6	306·95
Ayrshire	1	6	305	5,455·0	241·91
Red Poll	1	19	260	5,288·7	214·77
Guernsey	Not represented.				
Shorthorn	2	3	242	6,800·2	250·92
Totals and averages	183*	1,878	273	6,410·4	310·41

* Totals do not agree since some breeders tested more than one breed.

Table 2.—Average Production in Classes and Breeds for all O.H.T. Cows.

Class.		Season 1934–35.				Season 1935–36.			
		Number of Cows.	Average Days.	Average Milk.	Average Butterfat.	Number of Cows.	Average Days.	Average Milk.	Average Butterfat.
				Lb.	Lb.			Lb.	Lb.
Jersey	Two-year-old and under ..	582	286	5,252·4	282·42	503	288	5,460·7	300·10
	Three-year-old	218	287	6,139·9	341·51	265	290	6,166·1	339·36
	Four-year-old	199	286	6,465·8	346·45	173	287	6,474·5	360·53
	Mature	369	289	6,681·3	355·45	318	282	6,702·5	363·01
Friesian	Two-year-old and under ..	86	284	7,274·5	256·84	70	290	7,369·1	266·03
	Three-year-old	46	278	7,865·8	279·55	72	288	8,258·7	295·10
	Four-year-old	47	275	7,841·1	283·67	59	282	9,031·8	322·05
	Mature	106	289	9,447·5	338·24	162	292	9,686·7	343·22
Milking Shorthorn	Two-year-old and under ..	45	275	5,159·4	211·09	14	286	5,906·3	246·77
	Three-year-old	33	274	5,672·6	252·92	26	282	6,593·2	273·19
	Four-year-old	33	269	5,874·3	270·00	22	283	7,341·2	307·10
	Mature	71	281	7,597·2	301·63	43	282	8,922·2	360·02
Ayrshire	Two-year-old and under ..	6	291	5,099·7	209·79	5	305	5,442·3	241·03
	Three-year-old	2	287	5,844·2	245·40	1	305	5,518·1	246·31
	Four-year-old	4	303	7,338·4	292·02	..	..	..	..
	Mature	19	290	5,174·8	280·54	..	..	..	..
Red Poll	Two-year-old and under ..	4	234	3,324·3	134·44	3	251	4,883·6	215·17
	Three-year-old	..	..	..	..	4	287	4,529·9	179·88
	Four-year-old	..	..	..	..	4	274	6,285·2	238·72
	Mature	..	..	..	..	6	277	6,184·4	256·95
Guernsey	Two-year-old and under ..	2	305	4,739·8	252·77	Not represented.			
	Three-year-old	..	..	..	..				
	Four-year-old	..	..	..	..				
	Mature	4	298	5,249·6	280·51				
Shorthorn	Two-year-old and under ..	Not represented				..	..	..	..
	Three-year-old					..	..	..	..
	Four-year-old					1	219	7,509·4	273·25
	Mature					2	253	6,445·6	239·75

RATIONS FOR WINTERING PIGS.

RESULTS OF FEED-TRIALS AND OBSERVATIONAL TRIALS.

C. P. McMeekan, Massey Agricultural College, Palmerston North.

On the majority of dairy-farms engaged in pig-raising the question of how best to deal with a large proportion of the late-farrowed summer and autumn litters presents many difficulties. Owing to the rapid decline at this period in the supplies of fattening dairy by-products as a result of the seasonal system of dairying practised, it is impossible to fatten to satisfactory marketable weights the whole of the pigs normally on hand. Separated milk and whey are in insufficient supply for the purpose, and, under normal conditions, the use of grain or other concentrates to the extent necessary is unprofitable. As pointed out in a previous paper—(1) The judicious and limited use of concentrates as supplements can play a material part in reducing the number of unfinished animals during this period, and especially is this so when combined with rational control of farrow dates of breeding-stock so as to fit more closely the seasonal supplies of food; (2) useful as these methods have proved, however, they have not offered a complete solution to the problems.

Fattening being out of the question, farmers are faced with a choice between either selling as weaners or light stores in the late autumn at the low prices resulting from the small demand for such animals at this time or of maintaining them through the winter months in a growing condition for sale as forward stores when prices improve in the spring, or to be fattened when milk is again available at the commencement of the new season. The latter method is associated in practice with many difficulties, and, in consequence, tends to be avoided when possible by many producers. Of these difficulties the rationing aspect is only one, but it is one upon which little definite information exists, and which becomes particularly acute during the mid-winter period when milk-supplies either disappear altogether or are required by the breeding-stock. It is apparent therefore that the problem from the rationing angle involves the provision of cheap milk-by-product substitutes suitable for the purpose. With the object of obtaining information on the suitability of certain rations in this connection, and of investigating generally the economy of the practice of "wintering," the following feed trials were conducted by the writer during the winter of 1935, together with certain observational trials carried out with large numbers of pigs under practical farming conditions. It should be emphasized that this work relates not to winter fattening, but to the practice of maintaining otherwise unsaleable pigs in a fit growing condition through a period of feed shortage.

Outline of Experiment.

Forty pigs from six litters were taken and evenly distributed between five groups so as to eliminate differences due to strain and weight. The pigs were first-cross Tamworth-Berkshires, and all had

a common sire. The trial covered the May–July period. Each group was provided with comparable and comfortable feeding and housing quarters, together with a grass run-out pen.

One group was fed on the normal ration of the farm, and served as a control pen. The remainder were rationed in such a way as to provide comparisons between meat-meal and peas as "winter protein supplements," and between mangels and pumpkins as winter "roots." The actual rations were as follows:—

	Ration per Pig Daily.
Group 1 (Control)—Buttermilk mixture + pumpkins	1½ gallons for fourteen days; 2 gallons thereafter.
Group 2—Barley, meat-meal, and pumpkins	½ lb. meat-meal for fourteen days; ¾ lb. thereafter.
Group 3—Barley, peas, and pumpkins	½ lb. peas for fourteen days; ¾ lb. thereafter.
Group 4—Barley, meat-meal, and mangels	½ lb. meat-meal for fourteen days; ¾ lb. thereafter.
Group 5—Barley, peas, and mangels	½ lb. peas for fourteen days; ¾ lb. thereafter.

Barley (whole grain) was fed to all groups except the control at the rate of ½ lb. per pig daily for the first thirty days, and at ¾ lb. per pig daily thereafter.

The "roots" were fed at a standard rate to all groups—50 lb. per group daily in the case of both pumpkins and mangels.

The "buttermilk mixture" used with the control group was a standard mixture used on the farm, and consisted of 200 gallons of buttermilk, 200 gallons of water, 100 lb. of meat-meal, and 80 lb. of molasses.

The meat-meal used was commercial "pure meat-meal" showing 65 per cent. crude protein on analysis.

It will be noted that this arrangement provided the following comparisons:—

Group 2 with Group 3—Meat-meal compared with peas in association with pumpkins.
Group 4 with Group 5—Meat-meal compared with peas in association with mangels.
Group 2 with Group 4—Pumpkins compared with mangels in association with meat-meal.
Group 3 with Group 5—Pumpkins compared with mangels in association with peas.

The trial extended over fifty-nine days. Live-weights were taken at the commencement and at the end of the period. These were taken in the morning prior to feeding, the pigs being virtually in an "empty" condition.

Results obtained.

The pigs came through the winter well; health was good, and the animals finished in a thrifty condition. Increase in weight appeared to have occurred mainly through increase in size or frame rather than in condition or flesh and fat. There were no differences apparent in the appearance of the groups, except for a slight advantage in "bloom" of the pigs in the control-pen receiving

milk. Little nourishment appeared to be obtained from the grass pens, the pasture being at a dormant stage of growth and tending to disappear under the trampling effect of the animals as a result of wet weather. The following shows the live-weight increases :—

Table 1.—Live-weight Increases.

Group.	Initial Weight.	Final Weight.	Gain: Total.	Average Gain per Pig per Day.
	Lb.	Lb.	Lb.	Lb.
1	576 (average, 72·0)	736 (average, 92·0)	160 (average, 20·0)	0·34
2	588 (average, 73·5)	715 (average, 89·4)	127 (average, 16·0)	0·27
3	579 (average, 72·4)	776 (average, 97·0)	197 (average, 24·6)	0·42
4	593 (average, 74·1)	724 (average, 90·5)	131 (average, 16·4)	0·28
5	600 (average, 75·0)	761 (average, 95·1)	161 (average, 20·1)	0·34

Food-consumption results are set out in Table 2.

Table 2.—Food-consumption per 100 lb. Live-weight Increase.

Group.	Milk.	Pumpkins.	Mangels.	Barley.	Peas.	Meat-meal.
	Gallons.	Lb.	Lb.	Lb.	Lb.	Lb.
1	555	1,828	..	..	..	..
2	..	2,322	..	229	..	256
3	..	1,497	..	148	165	..
4	..	..	2,254	223	..	249
5	..	..	1,828	181	202	..

Consideration of Tables 1 and 2 indicates that from the point of view of the suitability of the rations for "wintering" all provided a satisfactory rate of growth as measured by the performance of the control group. Individually, both the meat-meal groups show less efficient results in both growth-rate and economy of food as compared with the two pea groups. Further, it is clear that—Peas gave better results than meat-meal when both were used with pumpkins; peas gave better results than meat-meal when both were used with mangels; pumpkins and mangels gave similar results when both were used with meat-meal; pumpkins gave slightly better results than mangels when both were used with peas.

This superiority of peas over meat-meal is of considerable interest in view of the usual recommendations with respect to these two foodstuffs. The agreement between the two meat-meal groups and the two pea groups respectively is very close, and the difference in growth-rate considerable. In view of the relationship of protein to flesh-production, and of the relative protein content of the two foodstuffs, it is generally believed that meat-meal, with its higher protein content, is the more effective of the two for use with pigs whose principal requirement is one of flesh and bone production rather than one of fattening. It is conceivable, however, in view

of the slow growth-rate of the pigs, that the greater part of the ration was utilized for maintenance purposes, and that accordingly much of the protein was unable to fulfil its normal function, but necessarily served as a source of energy. Since on theoretical grounds it is less efficient than carbohydrate for this purpose, it is possible that part, at least, of the difference noted may have been due to this cause. The matter warrants further investigation.

Economy.

Table 3 sets out the actual costs for supplements in each group and the costs in relation to the increase in weight. The latter figures provide a better guide as to the economy of the various rations, though the former are useful in indicating the expenditure involved in wintering pigs with the methods employed.

Barley, peas, and meat-meal are charged for at 1d. per pound, a figure approximating the average price of these foods. The home-grown materials, roots and milk, have not been allowed for.

Table 3.—Relative Costs for Concentrate Rations.

Group.	Actual Costs.	Costs per 100 lb. Weight Gain.
	s. d.	£ s. d.
1	4 2	1 0 1
2	6 6	2 0 5
3	6 6	1 6 3
4	6 6	1 19 4
5	6 6	1 11 11

It will be observed that the cost for purchased milk substitutes in Groups 2 to 5, over a two-month period during which gains of from 12 lb. to 25 lb. per pig were registered, amounted to 6s. 6d. per pig. This figure compares well with the control-pen cost where milk used permitted smaller quantities of concentrates to be employed. The figure excludes the cost of the roots employed, which if added at the rate of 12s. 6d. per ton (a normal commercial value), brings the total food-cost for wintering of the experimental groups up to 8s. 9d. per pig. At this figure all the groups were profitable, the price-margin between an autumn and a spring store pig being well in advance of this figure. The difference in growth-rate of the individual rations is, of course, responsible for the differences in the economy of the individual rations on a cost basis. Here Groups 3 and 5, using peas and barley with pumpkins and mangels respectively, show to advantage.

Observational Trials.

In addition to the above, careful observations were made on two large lines of farmers' pigs being wintered under conditions similar to those of the experimental groups on rations normally employed by the farmers concerned.

Trial No. 1.

In this trial there was a line of fifty-one pigs, born during February–April, and weaned on to carrots and chou moellier prior to coming under observation on the 1st June. From this date until the 1st August the pigs were wintered on a ration of grain, chou moellier, and roots (carrots and mangels). The pigs were weighed at the commencement and at the end of the period, and records kept of the quantity of food given. The following results were obtained:—

Initial weight	2,819 lb. (average, 55·2 lb.)
Final weight	3,682 lb. (average, 72·2 lb.)
Total gain	804 lb. (average, 16·9 lb.)
Days on trial	Sixty-two.
Average daily gain ..	0·27 lb.

The ration consisted of ½ lb. per pig per day of a mixture of 1 part of crushed barley and 2 parts of crushed oats for the whole of the period. This was supplemented with a run-out on chou moellier for the first thirty-five days (1¾ acres), and during the last twenty-seven days by an allowance of 25 lb. of mangels plus 2 oz. of meat-meal per pig per day. The ration and cost of same per pig for the whole period was thus as follows:—

Ration.	Cost.
	s. d.
Grain mixture, 31 lb.	2 7 at 1d. per pound.
Meat-meal, 4 lb.	0 4 at 1d. per pound.
Mangels, 625 lb.	3 6 at 12s. 6d. per ton.
Chou moellier	..
	6 5

It was observed during the course of the trial that the larger pigs seemed to thrive better and withstand the somewhat cold and wet weather prevailing than pigs that were small in size at the commencement of the trial. This observation was confirmed by the individual weights; many of the latter showed only small increases in weight, while some even lost weight though increasing in size during the period. A comparison between the rates of gain of "heavy" and "light" pigs gave the following results: Heavy pigs (average, 70 lb.), daily gain, 0·50 lb.; light pigs (average, 47 lb.), daily gain, 0·20 lb.

This observation is of considerable interest, and if substantiated by further investigation will provide a further reason in addition to those already operative in favour of early farrowing, so that pigs will be of sufficient size before the winter commences. It might be noted that the difference between the light and heavy pigs was not due to competition between them for food; feeding was organized in such a way as to ensure each pig obtaining its share of the daily ration.

Trial No. 2.

Two lines of pigs of twenty-nine and twenty-four animals respectively were kept under observation under similar conditions

to the above. The trial extended over the same period. The ration consisted of a small allowance of buttermilk daily, which was fed warm (approximately 1 gallon per head daily), supplemented with ½ lb. of peas in the case of Lot 1 and ½ lb. of barley in the case of Lot 2. Both groups also received an allowance of mangels of approximately 12 lb. per head per day. The results were as follows:—

LOT 1 (PEAS).

Initial weight ..	.. 2,530 lb. (average, 87 lb.).
Final weight ..	.. 2,937 lb. (average, 101 lb.).
Gain in weight ..	.. 407 lb. (average, 14 lb.).
Average daily gain	.. 0·24 lb.
Days on trial ..	.. Fifty-nine.

LOT 2 (BARLEY).

Initial weight ..	.. 2,270 lb. (average, 94·5 lb.).
Final weight ..	.. 2,883 lb. (average, 120 lb.).
Gain in weight ..	.. 613 lb. (average, 25·5 lb.).
Average daily gain	.. 0·43 lb.
Days on trial ..	.. Fifty-nine.

It will be observed that the two lots received the same ration apart from the concentrate supplement. The lot receiving barley showed the better growth-rate. This difference cannot be considered significant, however, for the two lots were not strictly comparable on a breed and strain basis, while the barley group had a possible advantage through having continuous access to good-quality leafy pasture, while the pea group were provided with soiled pasture of inferior quality.

The data are of interest, however, in indicating the results being obtained in practice with rations similar in type to those of the experimental groups. The pigs maintained a satisfactory rate of growth for the purpose of wintering, and came through in good thriving condition, increasing in value by many times their feed-cost during the period. The cost was low, being that of 30 lb. of grain per pig in each case. At 1d. per pound this gives a wintering charge for purchased foods of 2s. 6d., to which must be added the mangels, at 3s. 6d. per head.

SUMMARY.

The trials discussed show that pigs can be successfully carried over the winter period of food-shortage on a ration of milk substitutes. Mangels and pumpkins as cheap home-grown sources of energy are compared for the purpose, as also are meat-meal and peas, which, as concentrate supplements to a basal ration of roots and grain, are readily available.

Peas gave more efficient results than meat-meal, both with mangels and pumpkins. The latter two foodstuffs gave similar results. The rations employed, however, were sufficient only to maintain the pigs in a thriving condition, and added but slightly to their live-weight. Any increase in weight occurred mainly in respect to size rather than condition.

For the purpose for which they were designed, however, the results indicate that the rations employed present definite possibilities as an alternative to the method of disposal of late-farrowed pigs during periods of low prices.

The results of the trials are supported by observations on large groups of pigs on similar rations under practical farming conditions.

ACKNOWLEDGMENTS.

The investigations reported were carried out in conjunction with the Manawatu-Oroua Pig Development and Recording Club. The thanks of the writer and the club are due to the Cheltenham Dairy Co. for the facilities provided for the feed trails; to the manager, Mr. H. E. Thurston, who carefully carried out the feeding and provided other assistance; to other farmers who co-operated in respect to the observational trials at considerable inconvenience to themselves; and to Mr. W. J. Croucher, recording officer of the Club, for generous assistance in the organization of the work.

REFERENCES.

(1) Use of Concentrates with Factory Buttermilk in Fattening Bacon Pigs. *New Zealand Journal of Agriculture;* December, 1936.
(2) Management of Pigs on Dairy-farms. *New Zealand Journal of Agriculture*; July, 1936.

Dress all your seed with . . .

'CERESAN'

BAYER'S DRY SEED DRESSING

(U.T. 1875 a) TRADE MARK

for BIGGER and BETTER CROPS

'CERESAN' is the leading seed treatment for controlling bunt or stinking smut of Wheat, covered smut of Oats, covered smut of Barley and diseases of Peas, Beans, Swedes, Turnips and other crops. In addition, 'CERESAN' stimulates germination, prevents seed decay, improves early growth, and INCREASES THE YIELD OF A BETTER TYPE OF GRAIN.

BAYER

SOLD BY STOCK AND STATION AGENTS AND GRAIN MERCHANTS.

'CERESAN' gives:—

BETTER GERMINATION
BETTER CONTROL OF DISEASES
BIGGER YIELDS OF A BETTER TYPE OF GRAIN

SEED CERTIFICATION.

SUMMARY OF OPERATIONS FOR SEASON 1935–36.

J. H. CLARIDGE, Certification Officer, Fields Division, Wellington.

THE seed certification controlled by the Fields Division of the Department of Agriculture has now been in operation for a period of nine years. This report covers the activities during the 1935–36 season. While no major amendments to the work were made during the period under review, the certification of *Phalaris tuberosa* seed was introduced. The development of the production under certification of supplies of pedigree grass and clover seed has been a feature of the season's activities, while for the first time an appreciable quantity of rape-seed was accepted for certification.

A further increase in the total entries accepted for 1935–36 season, amounting to 30 per cent., has brought the number of crops under certification to the total of over 3,000. This increase has been attributable in the main to a phenomenal increase in entries for seed-wheat certification, and also to quite considerable increases in the entries received in connection with perennial rye-grass and seed-potatoes.

GOVERNMENT PEDIGREE STOCK SEEDS.

One area of perennial rye-grass, and several areas of white clover, sown with specially selected nucleus stock seed, were grown on contract by the Department during the 1935–36 season, the produce of these areas being accepted for certification as "Government Pedigree Stock" seed.

A heavy yield of perennial rye-grass seed was obtained, and the complete harvest, amounting to 800 bushels, was readily disposed of through trade channels. It was unfortunate that the season for white-clover-seed harvesting was very unfavourable, as only two of the areas could be saved for seed, and from these very small quantities of seed were obtained. On account of the short supply many orders for this seed remained unfilled.

It is expected that larger quantities of both perennial rye-grass and white-clover seed will be available from the coming harvest for distribution during June next.

PERENNIAL RYE-GRASS.

The entries into certification in the "mother" and "permanent pasture" classes were, in general, slightly lower than in the 1934–35 season except in the Hawke's Bay district, where the number of entries increased by 100. On the other hand, a complete year's activities relative to the "commercial" class of seed accounted for the examination of 525 lines of seed, representing a somewhat similar number of areas. Over 100,000 bushels of seed (40 per cent. of the total quantity certified) was accepted in this class. The total quantity of perennial rye-grass seed certified during the 1935–36 season (279,000 bushels) is 50 per cent. in excess of the 1934–35 total, and is the greatest quantity yet certified in any one season. It is estimated that over the last three seasons approximately one-third of the perennial rye-grass seed harvested in New Zealand has received official recognition under the certification scheme.

Cocksfoot.

There has been little alteration in the quantity of cocksfoot seed certified in the 1935–36 season, a lower acreage harvested being almost offset by an increase in the yield per acre. In all, 657,000 lb. of machine-dressed seed was sealed and tagged as certified, two-thirds of this quantity being produced on the Akaroa Peninsula by members of the Akaroa Cocksfoot Seed Growers' Association. Practically the whole of the remaining seed was harvested from the mid-Canterbury district. It is very noticeable that little of the seed certified as "mother" is being used in the establishment of new areas for further seed-production. Most of the seed certified is the produce of older-established areas.

White Clover.

The 1935–36 season was exceedingly unfavourable in so far as the white-clover harvest was concerned. As a result, fewer areas were harvested, while the yield per acre was also reduced considerably. A total of 56,000 lb. of machine-dressed seed was certified, as compared with 96,000 lb. during the 1934–35 season.

Brown-top.

While the acreage entered for brown-top certification has remained fairly constant, the yield of seed obtained in the season just concluded has shown a considerable reduction. Only 362,000 lb. of seed was finally sealed, as compared with 634,000 lb. during the 1934–35 season.

Red Clover.

As with white clover, seasonal conditions had an adverse effect on the production of certified Montgomery red-clover seed. A reduction in the acreage harvested as compared with the 1934–35 season, together with a yield reduced from 156 lb. per acre to 119 lb. per acre, has resulted in a reduction in the total produce certified from 32,000 lb. to 23,500 lb. In addition, the sample produced has not been as bright in colour as in past seasons. There has, however, been no difficulty in regard to the disposal of all seed harvested under certification, and it appears that a good export trade in this seed might reasonably be expected.

Italian Rye-grass.

The certification of Italian rye-grass seed has, in its second season of operation, progressed very satisfactorily. Of thirty-one areas entered, twenty-eight passed field inspection, producing 2,500 sacks of field-dressed seed. Quite a considerable portion of this seed (mostly that certified in the commercial class) was not machine-dressed, so the total of 6,600 bushels of machine-dressed seed rather understates the position. The average yield of this seed was 29½ bushels per acre.

Certified Italian rye-grass seed is meeting with a very favourable reception both in this country and in Australia, where quite a demand has already been created. It is confidently anticipated that the amount of Italian rye-grass seed coming under certification may be increased very many times without fear of exceeding the demand.

Phalaris Tuberosa.

Phalaris tuberosa is recognized as a very valuable grass for certain localities in Australia, but a drawback to its wider use is the high price of seed. Last season an attempt was made to produce seed in New Zealand under certification. Seasonal conditions were not of the best, and the seed crop in respect of two of the areas was a failure. From a third area 2,500 lb. of seed was obtained from 6 acres, which indicates that the prospect in regard to the production of *Phalaris tuberosa* seed is quite hopeful.

Wheat.

The acreage under wheat certification during the 1935–36 season was more than double that of the previous season. Entries were confined almost entirely to four varieties—Solid Straw Tuscan, Cross 7, Hunter's II, and Dreadnought.

Twenty-five thousand bushels of certified seed wheat were sealed and tagged during the 1935 36 season, while a further 10,000 bushels of seed from certified crops was passed at grain inspection, but not submitted for machine-dressing. The rapid dissemination of seed of the Cross 7 variety which has taken place in the last two seasons is very striking and emphasizes the value of seed certification in the speedy distribution of superior stocks of a new variety. In 1933–34 one small area of Cross 7 was under certification while in 1934–35 the number had increased to six crops. In 1935–36 season 105 crops, comprising 1,600 acres, were entered. Approximately half this area was accepted for certification, and 10,000 bushels of machine-dressed seed were sealed and tagged in this the third season during which seed of this variety has been available commercially.

Seed Potatoes.

Entries into potato certification have continued to increase, 686 crops having been inspected in the 1935–36 season, as compared with 513 crops in the 1934–35 season. The percentage of crops to reach certification standard (89·7 per cent.) is the highest on record, having increased from 56·4 per cent. in the 1932–33 season. Over 2,800 tons of potatoes, the produce of certified crops, were inspected after grading and accepted as finally certified seed.

Figures recently published in the *Monthly Abstract of Statistics* indicate that throughout the whole of New Zealand the yield from certified seed during 1936 was 1½ tons per acre (25 per cent.) higher than where uncertified seed had been planted. This independent estimate, based on figures returned to the Statistican by farmers themselves, indicates the true worth of certified seed potatoes.

Brassica Crops.

Four areas of rape, two each of Giant and Broad Leaf Essex type, were sown out in 1935 with seed raised at the Plant Research Station. These areas, comprising 31 acres, were harvested in the 1935–36 season, the produce, amounting to 24,500 lb., being accepted as certified seed. This is the first time that rape-seed has been available to farmers in New Zealand with any reliable assurance as to the type of rape which is being

Table giving Quantities of each Seed certified and Estimate of the Total Value of Seed certified in each Season.

Seed.	Chief consideration upon which Certification is based.		Quantities of Seed finally certified.								
			1927–28.	1928–29.	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.	1934–35.	1035–36.
Potatoes ..	Varietal purity, cropping-power, and freedom from virus disease	Tons	217	249	511	760	818	938	1,806	1,821	2,823
Wheat ..	Varietal purity and freedom from loose and stinking smuts	Bush.	3,840	11,682	16,714	4,060*	1,283*	7,001	6,012	11,110	25,646
White clover	Age of pasture, 1928–31; type of clover, 1931–35	Lb.	..	10,595	69,015	67,242	6,131*	33,731	20,337	93,381	56,092
Perennial rye-grass	Genuine perennial type	Bush.	..	..	17,052	45,982	81,186	245,667	119,019	182,386	279,305
Brown-top ..	Freedom from red-top (*Agrostis palustris*)	Lb.	..	..	170,071	171,083	198,343	138,843	118,978	384,588	212,734
Cocksfoot ..	Type as exemplified in the produce of Akaroa Peninsula	,,	..	..	..	..	171,720	622,765	200,560	715,982	657,319
Red clover ..	Type conforming to that of English-grown Montgomery red clover	,,	..	..	..	..	1,550	3,763	17,263	32,193	23,620
Brassicas ..	Varietal purity and freedom from disease	,,	..	..	..	..	..	..	22,515	522	24,503
Italian rye-grass	A rapid-growing high-producing type, showing recovery after cutting	Bush.	..	..	..	..	..	..	..	5,121	6,669
Philaris tuberosa	Freedom from other species ..	Lb.	..	..	..	..	..	..	..	..	2,701
Estimated value of seeds finally certified			£2,070	£4,889	£30,328	£40,048	£57,358	£142,585	£79,018	£154,725	£184,501

* Reductions accounted for by changes in regulations.

Total estimated value of seed certified (1927–36), £695,522.

purchased. The additional benefit of freshness is a further factor for consideration in the purchase of this seed. In addition, the yielding-capacity of the strains of seed to be distributed in coming seasons is superior to that of commercial samples, so that there is every reason to believe that purchasers of rape-seed will avail themselves of this article locally produced under certification.

General.

In the accompanying table are recorded the quantities of the various seeds certified since the inauguration of certification in 1927, together with an estimate of the value of seeds certified in each season. Attention is drawn to the fact that this table includes only seed in a machine-dressed or graded condition, and does not include seed harvested but not submitted for machine-dressing, or, in the case of potatoes, seed not submitted for tuber inspection. Persons or firms interested in the complete tabulated results may obtain copies of these on application to the Director, Fields Division, Department of Agriculture, Wellington.

WOOL-PRODUCTION.

Information as to production of wool is not obtainable directly; but it is possible to compute fairly accurate figures on the basis of exports and local consumption during the twelve months ended 30th June, and the variation in stocks revealed by the annual census of stocks of wool held on 30th June.

In the following computation of total production, scoured, washed, and slipe wool has been converted to a greasy basis on the assumption of an average loss of 33⅓ per cent. in weight, while wool exported on skins has been taken at an average of 4 lb. per skin.

	Year ended 30th June,						
	1930.	1931.	1932.	1933.	1934.	1935.	1936.
	Million lb.						
Exports of wool	207·2	244·3	248·1	310·0	308·9	222·3	344·1
Exports of wool on skins ..	4·8	6·4	6·8	11·1	14·4	9·0	8·2
Used by New Zealand mills ..	6·1	6·2	7·0	6·6	6·0	7·1	7·8
	218·1	256·9	261·9	327·7	329·3	238·4	360·1
Variation in stocks	+54·8	+14·2	+20·9	−39·3	−28·8	+37·5	−43·6
Estimated production ..	272·9	271·1	282·8	288·4	300·5	275·9	316·5

The collection of wool statistics has been reorganized on a basis which permits of the application of the above formula for ascertaining total wool-production for each season from 1929. It will be seen that the latest figure of 316,500,000 lb. is easily the largest recorded during the period shown. Records prior to the 1929 season (although not on a strictly comparable basis) indicate that the 1935–36 figure has never been exceeded in any season in New Zealand's history.

The high production of wool last season may be attributed to the very favourable conditions experienced during the period of growth, assisted by late shearing operations due to a wet summer. It is now evident that, on the average, the relatively high yield of over 9 lb. of wool per sheep was obtained at shearing.

IMPORTATION OF FERTILIZERS IN YEARS 1934-35 AND 1935-36.

THE following particulars of the importation of fertilizers into New Zealand for the years ending 31st March, 1935 and 1936, have been compiled by the Inspector of Fertilizers, Fields Division, Department of Agriculture, Wellington, from returns furnished by courtesy of the Comptroller of Customs :—

Table I.—Summary of Fertilizer Importations, 1935–36 and 1934–35.

	Quantity (in Tons).	
	Year 1935–36.	Year 1934–35.
Bonedust and bone-char	30	80
Basic slag	51,390	9,217
Seychelles soft-phosphate*	5,879	22,089
Nauru and Ocean Islands phosphates	209,751	170,838
Island phosphate (other)†	8,815	3,304
Egyptian phosphate	1,000	1,400
Phosphate (not otherwise specified)‡	7,405	10,237
Kainit	845	840
Muriate of potash	75	262
Sulphate of potash	838	733
Potash salts (other)	7,076	7,386
Sulphate of ammonia	4,033	5,100
Nitrate of soda	1,620	1,511
Fertilizers unspecified	175	95
Sulphate of iron	23	10
Totals	298,955	233,102

* Includes all soft-phosphates from Seychelles Islands and islands in vicinity. † Soft-phosphates from New Caledonia, includes 55 tons from Peru year 1935–36 and 25 tons year 1934–35. ‡ Chiefly from Belgium—presumably North African phosphate mined in Tunisia and ground in Belgium.

Table II.—Imports of the Principal Phosphatic Fertilizers, 1927–36.

Year ended 31st March,	Bonedust and Bone-char.	Basic Slag.	Super-phosphate.	Pacific and Indian Oceans Phosphate.	Egyptian Phosphate.	Moroccan Phosphate.	North African Phosphate (other).
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1927	1,805	53,327	15	161,541	5,979	..	..
1928	725	48,913	6,616	143,373	6,603	13,389	..
1929	554	93,222	1,037	178,057	6,000	22,173	12,499
1930	1,420	94,332	525	170,997	1,000	35,348	37,424
1931	795	67,766	..	156,950	..	8,038	250
1932	180	47,776	300	178,466	..	..	4,738*
1933	30	42,022	..	214,445	160	..	6,024*
1934	..	14,982	..	182,333	350	..	5,437*
1935	80	9,217	..	196,231	1,400	..	10,237*
1936	30	51,390	..	224,445	1,000	..	7,405*

* Includes phosphate (not otherwise specified) which is chiefly North African phosphate ground in Belgium.

SEASONAL NOTES.

THE FARM.

Subterranean Clover.

DURING recent years attention given to field experience in New Zealand with subterranean clover has resulted in a considerable knowledge of its value in our farm economy and its appropriate management under various conditions. It has been established that subterranean clover may be made of outstanding value under a wide range of conditions of soil and climate. The position in the North Island in this respect is discussed elsewhere in this *Journal*. In the South Island the results of pioneering work described by Neave and Hewlett in the September, 1935, issue of this *Journal* has been repeated in essential features elsewhere, and the current available information points to the future development along the drier eastern portions of the South Island of what may be called a "subterranean clover belt," on account of the fact that subterranean clover will hold a key position in building and maintaining the fertility and production of the belt. A similar belt along the drier eastern portions of the North Island is already in its early stages of formation. The utilization of subterranean clover in the drier eastern portions of New Zealand promises to parallel to a large extent what has been done in correspondingly dry portions of Australia.

The outstanding value which has been shown to attach to subterranean clover in certain of our drier areas is due primarily to two facts: (1) it is a broad-leafed edible palatable legume, (2) it is a freely reseeding annual the vegetative activity or growth-period of which naturally coincides with satisfactory supplies of water in the soils, and largely avoids inadequate supplies—the plant is vegetatively dormant only for some weeks during mid-summer, and it is during this period that the supplies of soil moisture are normally lowest.

Its being a legume ensures not only that it is practically independent of supplies of nitrogenous matter of which the extensive open soils of the dry eastern districts are so deficient as to be unable, as a rule, to produce economic yields of most other crops, but also that the content of nitrogenous organic matter of such soils is increased relatively rapidly by thriving crops of subterranean clover. As a result the general fertility of such soils becomes so improved that eventually they become capable of supporting successfully plants of high requirements in respect to fertility, such as perennial rye-grass and cocksfoot, which could not be grown profitably on such soils in their natural state.

Its being a broad-leafed edible palatable clover makes it an appropriate component of the rations of milk-producing stock, be these sheep, cows, or pigs, and its high value for such stock has been demonstrated.

Subterranean clover, being an annual which freely resows itself, becomes, for practical purposes, a perennial crop with which is associated the low cost of annual upkeep that is found so attractive economically in those crops such as prolific permanent pastures and lucerne in which establishment costs are spread over the production of a series of years. The standard of natural or unimproved production of the soils of the eastern districts on which subterranean clover is being used successfully is so low as to discourage greatly the culture of any crop calling for relatively high annual cost of upkeep such as is almost necessarily linked with frequent sowing of crops. Prior to the use of subterranean clover no satisfactory method of substantially improving such soils fairly rapidly has been practised.

The fact that subterranean clover when suitably nourished and utilized normally provides leafy, very nutritious feed during most of that portion of the year between late summer and the following mid-summer is indicative of its potentialities in both sheep-farming and dairying. It provides leafy feed for practically the whole period during which such feed is especially required in fat-lamb production. The gap in its production in summer is of importance in dairying: a measure that is effective in assisting to bridge this gap is the provision of an area of lucerne under conditions suitable for lucerne culture—lucerne produces well just when the production of subterranean clover is at its lowest.

Outside the relatively arid areas of about 30 in. of annual rainfall or less, subterranean clover has proved valuable especially because of its production, from autumn to the following spring inclusive, on poorish somewhat heavy soils, as well as on open soils.

A fairly wide field experience in the sowing of subterranean clover can now be drawn upon. Only a very limited amount of spring sowing has come under notice, and this has not been successful. On the basis of results, late summer or early autumn sowing rightly is favoured. Usually, if not always, successful results have been linked with the application of phosphates which may be considered essential in the most profitable use of subterranean clover.

On worn, open pastures success has followed the broadcasting on the surface of 1 lb. of seed an acre; under similar conditions better and quicker returns have been obtained from increasing the seeding to 2 lb. an acre, and it is considered that still more attractive economic results are obtainable under the same conditions from the use of up to 4 lb. an acre of seed, although on this point no definite data are available. Surface broadcasting of seed in poor but nevertheless compact swards has on several occasions given disappointing results, and when ploughing of such swards prior to the sowing of subterranean clover is practicable it is recommended.

Because of the difficulty of keeping white clover in a pasture dominated by paspalum, it is at times advisable to introduce into such a pasture subterranean clover, which serves usefully in conjunction with paspalum. Hence when a special paspalum pasture is being established it is as a rule advisable to include ½ lb. to 1 lb. of subterranean-clover seed an acre. Much greater quantities of subterranean-clover seed, ranging up to 6 lb. or 7 lb. an acre, have been used in conjunction with paspalum, but whether they are justified seems to be a matter of opinion—they may be expected to lead to quicker prominence of the subterranean clover.

On light country in eastern districts of the North Island, 2 lb. to 5 lb. an acre of subterranean clover have been added with beneficial results to practically standard seed-mixtures for permanent pastures suitable for such land; the tendency is to favour the larger quantities of subterranean clover. For the purpose of obtaining special subterranean clover areas, 5 lb. to 10 lb. an acre of subterranean clover sown alone or in conjunction with 20 lb. to 30 lb. an acre of Italian rye-grass has given good results.

In Canterbury, on the farm of the Canterbury (N.Z.) Seed Co., Ltd., near Leeston, a mixture of 10 lb. to 12 lb. of cocksfoot and 2½ lb. to 3 lb. of subterranean clover an acre has proved quite satisfactory.

Experience suggests for the West Coast of the Wellington Province and for localities with similar conditions the use of 2 lb. to 4 lb. an acre of subterranean clover, both for broadcasting on existing swards and for inclusion in mixtures to be sown on cultivated ground. The tendency to favour the larger amount of seed increases. As in the eastern districts of the North Island, for obtaining quickly a special subterranean clover area the use of 5 lb. to 10 lb. of subterranean-clover seed an acre is considered advisable. Specific guidance about the use of subterranean clover under particular conditions and for particular purposes is obtainable from local officers of the Fields Division.

Autumn Top-dressing.

On many farms some at least of the pastures advantageously may be dressed with phosphates in February or thereabouts. When the supply of moisture in the soil is sufficient to admit of growth, then the application of phosphates at the time mentioned usually increases the leafy growth of pastures from shortly after the phosphates are applied until well into the beginning of winter. Hence the feed position during the critical winter and early spring period is strengthened. Further, during the following spring and summer, the stimulating influence of the phosphate continues, although not so intensely as if the phosphate were applied in the winter or early spring. Hence the application of phosphates in the late summer or early autumn tends to a more even growth of grass throughout the year than does the spring application of phosphates, and therefore efficient grazing management of pastures can be obtained more easily under autumn application than under spring application of phosphates. It should be borne in mind, further, that both autumn application and spring application of phosphates increase the absolute gap between the peak of high production and that of low production of permanent grassland, and that both therefore intensify the need for provision of special feed for use during the critical periods in which the amount of feed directly available from grassland is customarily below the current requirements of the stock, unless substantial under-stocking is practised.

Preparation for Autumn Sowing of Pastures.

On many farms a summer task of prime importance is the preparation of ground for the autumn sowing of pastures. In this task many seem to appreciate but imperfectly the great value of thorough cultivation in the production in the seed-bed of the fine firm condition which so usefully fosters successful establishment of seedlings. The value of firmness of seed-beds is indicated to some extent by the superior pastures that often are found along "headlands" of fields or along tracks where there is greater consolidation than in the remainder of the field, this being due to additional passage of stock or of machinery. The advisability of fineness in the seed-bed may be realized readily by considering what must be the fate of many of the small seeds used in pasture-seed mixtures when the soil is in a coarse or lumpy condition: any of these small seeds covered by lumps cannot with their limited supply of energy push their shoots to the surface.

In districts in which the ravages of the grass-grub have been much in evidence during recent seasons, it is inadvisable to sow pastures in land which in the immediate past has been occupied by a cereal or by grass. On the other hand, the more land was without a plant-covering from November to December, the period in which the eggs which develop into the grass-grub are deposited in large numbers, the more likely is the land to be free from the grub during the following twelve months.

Control of Pasture-growth in Summer.

Widely more attention than is given should be given to the quality of the feed which is provided by the pastures in summer. This matter is of special importance in dairying. The crux of the position is the fact that the quality of the feed provided by pastures is governed to a large extent by the stage of maturity of that feed. Stemmy or woody growth such as results when flower-stalks are allowed to develop is of low feeding-value. This explains why, at times, the production of dairy stock falls off at an unduly rapid rate, or lambs fail to develop satisfactorily when the animals seem to be in the midst of plenty.

Further, the development of flowering parts in pasture-plants not only leads to a considerable decrease in the nutritive value of the feed, but also is connected causally with a considerable falling-off in the rate of growth:

it seems natural for plants which have flowered and matured to become quiescent for a period, and during this period supplies of leafy feed may be undesirably scant. In February "topping" of pastures by light mowing may be advisable in the interests of feed-quality: in this "topping" the aim should be to remove merely the portions of the sward which are rank or producing seed, in order to stimulate the production of fresh leafy growth from the base of the "topped" plants. Somewhat close mowing, especially if the conditions at the time are dry or become dry shortly afterwards, may be definitely harmful. Appropriate mowing of pastures may also serve usefully at this stage to remove shade-creating parts of such weeds as docks, thistles, red-shank (willow-weed), and fat-hen. If these weeds are not dealt with they are likely to weaken greatly the pasture-plants in their vicinity, and probably to create vacant patches on which, later on, inferior plants become established.

"Topping" in the manner just specified is likely to be especially effective in the production of leafy growth when it is carried out in conjunction with top-dressing as already discussed. Attention to such matters as "topping" and summer top-dressing is particularly advisable on the part of those whose policy it is to depend more and more upon pastures for the feed for their stock. On the other hand the use of such crops as soft turnips and rape, which are markedly low in woodiness and high in digestibility when used at an appropriate stage, offsets excessive woodiness due to over-maturity in the portion of the ration obtained from pastures. Only leafy pasture-growth, low in stemminess or woodiness and high in digestibility, can efficiently replace standard successful summer supplementary crops such as rape and soft turnips. Whether such leafy pasture-growth in practice can or should be made wholly to replace summer supplementary crops is a management problem to which probably no generally valid answer can be given, and about which we are not at present directly concerned.

Work with Special Crops.

The sowing of certain special crops in late summer is at times distinctly advantageous. For instance, land from which a cereal crop has recently been harvested if sown without delay in Italian or Western Wolths rye-grass (25 lb. to 30 lb. an acre), and red clover (5 lb. to 6 lb.) usually provides autumn and winter feed that is likely to be distinctly useful, especially to sheep-farmers under Canterbury and similar conditions. The use of cereal crops as catch-crops productive of winter feed was discussed last month in these notes, which continue to be seasonable.

If arable land is known to be foul with the seeds of annual weeds such as fat-hen, spurrey, and nightshade, which germinate in the spring or early summer more freely than at other seasons, then the cropping of such land should be planned so that the land is sown in the autumn when the crop may be more likely to become established without the grave competition from such weeds against which spring-sown crops are almost certain to have to struggle.

Young lucerne sown in November or December is often fit for mowing in February, but it should not be mown until flowering has commenced, unless weeds threaten to weaken the lucerne-plants by the shading that they cause. Mowing prior to flowering militates against the development of the root-system, and persistent sturdiness and heavy yield of lucerne is associated with an extensive root-system. Usually top-dressing lucerne with phosphates in summer profitably increases its vigour.

The effective use of special summer feed grown to supplement the pastures is of importance and is discussed in these notes in last month's *Journal*, which suitably may be considered for current guidance.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Seasonal Spraying.

MANY growers throughout the Dominion make a very serious mistake by discontinuing spray applications many weeks too soon. Presumably this is done for economic reasons, it being considered that the cost of spraying towards the latter part of summer and early autumn is not warranted. This view, however, is a "penny-wise and pound-foolish" one. The discontinuing of spray applications too early in the season inevitably results in a far greater percentage of rejected fruit during the process of grading. The result of a few insect stings, injury of leaf-roller caterpillar, or pinhead black spot, individually or collectively, is all that is required to reduce otherwise extra fancy fruit to the reject class. In view of these circumstances it is recommended that pip-fruits be sprayed as recommended in the November notes, for the control of black spot, leaf-roller caterpillar, and codling moth. If red mite is still prevalent it will be necessary to spray with summer-oil 1–80.

In order to reduce spray residue, early varieties of apples, such as Gravenstein, which are intended for export, should not be sprayed later than fourteen days previous to picking.

Stone-fruits should still receive attention by periodical applications of the sprays recommended in last month's notes.

Harvesting the Crop.

The importance of care in the preparation of fruit for either local or export markets cannot be emphasized too strongly, as considerable losses accrue through faulty handling during the picking, grading, and packing operations.

The packing of the crop calls for considerable discretion and care on the part of the picker. Carefully picking to size and eliminating the obvious culls greatly facilitate the work in the packing-shed. Rejected and fallen fruit should not be allowed to remain on the ground, but should be gathered, and if not utilized should either be buried deeply or burned.

Attention should also be paid to maturity, and several pickings should be made; the fruit should be removed when it has reached the required degree of ripeness for the market it is intended to supply. The more distant the market the earlier the fruit should be gathered to ensure its arrival on the market in good marketable condition. In gathering fruit for export attention should be directed to the degree of maturity rather than colour. Much has been written about the necessity of picking to colour and colour standards, but this is apt to be misleading to the grower or picker, as, while the fruit remains on the tree to attain a high colour, it may become over-mature for transport to the market.

Select early picking is of great benefit, as the removal of the mature and larger fruit accelerates the "sizing-up" of those remaining, and also tends to improve the colour of such fruit. The fruit should be removed carefully without damaging the fruit spurs or tearing out the stalks from the fruit. When picked the fruit should not be left standing in the sun, but removed as soon as possible to the packing-shed.

A simple and reliable test for the maturity of apples is made by cutting an apple in half from cheek to cheek, and if the main vascular bundles are linked up the apple is not sufficiently forward to pick. Once the points are unlinked, however, the apples are sufficiently mature for picking.

Budding.

When weather conditions are suitable and little difficulty is experienced in lifting the bark, budding may be proceeded with. When budding stone-fruits it is advisable to make the horizontal cut at the bottom and the

vertical cut to go up instead of down (as in the usual practice of budding), as this lessens the gumming which so often occurs when budding stone-fruits.

Fireblight.

A sharp lookout for twig infection by fireblight should be kept where blossom infection was experienced. It is usually from the sappy growths that ooze develops, and their cutting-out and destruction helps materially towards preventing subsequent extension of the trouble. Care should be observed in keeping the pruning secateurs sterilized, and large cut surfaces should not be left unprotected. These should be covered with a bitumen emulsion or other suitable material.

—B. G. Goodwin, Orchard Instructor, Christchurch.

Citrus Notes.

Disease Control.—Provided the weather has been hot and dry, citrus red scale, if present on the trees, will be hatching freely in most districts. An application of summer-oil 1–33 should be applied forthwith (see December Notes). Where infection is at all extensive, at least two applications should be made at an interval of about one month. Thorough spraying is essential, and occasionally operators should examine a tree which they have just sprayed. If it has been done properly there should be no dry spots on any part of the trees, especially underneath and on top of the foliage, all branches, fruit, trunk, &c. Experienced growers who have taken the trouble to make this examination have often been surprised to find that portions of trees which they had thought to be well covered have received little or no spray. Now that the rush of spring work is over, a further examination of the trees should be made for bark blotch and borer, and where these are detected appropriate action should be taken. Any old wounds which are showing signs of losing their protective covering should be "gone over" again with bitumen emulsion or tar. If the latter is used, a mixture of coal-tar and Stockholm tar in equal proportions is the best.

Green Manuring.—It is now time to give consideration to the important matter of green manuring. To obtain the greatest amount of growth from green crops for ploughing under in the spring, the seed should be sown early enough in the New Year to catch the first break in the dry weather and while the ground is likely to remain warm for a further two or three months. Generally, early February is a good month in which to sow lupins, either blue or white, field peas, tares, oats, or whatever is decided upon as being most suitable for the grower's particular district. It appears to be agreed universally that one of the main requirements of citrus trees is organic matter or humus. In the older groves it is difficult to grow an adequate supply of green material between the rows owing to the spread of the trees and the continual tramping-down of the soil which takes place due to the fact that picking of lemons is carried on almost continuously. In those cases where the crops cannot be grown satisfactorily between the trees, it is necessary to consider growing them on adjacent ground and carting the material on to the orchard. Owing to this difficulty of growing green crops in a mature citrus grove (particularly in the case of lemons), the importance of the ploughing-in of cover-crops in the first few years from planting, while the space is available, should not be lost sight of. The tendency to use the space between young trees for revenue-producing crops to the detriment of the supplying of humus should be resisted. Where cowyard or sheep manure is available it should be used in large quantities.

Young Trees.—Young trees require attention during the hot dry weather. Light cultivation should be continued, and, if the rainfall is not sufficient to keep the foliage from wilting, a good watering may be the means of assisting the trees to become well established. Watering, like most beneficial things, can be harmful if it is overdone. Water lowers the temperature of the soil,

and continual applications without sufficient intervals for aeration and warming the ground cause a slowing-up of growth. If some of the trees are not doing as well as others, thought should be given to the cause of this condition, and, if possible, a suitable remedy applied. There may be weak spots in the shelter-belts, and where a number of young trees are exposed to strong winds it pays to shelter these individually by means of stakes and scrim. Some growers are under the impression that it is only the cold winds which cause damage, but this is not so, as hot winds or even temperate ones do just as much harm if the necessary force is behind them. The writer wishes to place special emphasis on this matter of sheltering young citrus trees, as several instances have come under his notice where blocks of the best trees procurable in the country have made no progress whatever during the past two years owing to their exposure to high winds. The aim of the grower is to get the trees into profitable production as early as possible. It is quite evident that a small expenditure for the purpose of supplying additional protection in the early stages of the orchard is repaid many times over by way of earlier and larger returns of fruit. The matter of fertilizing the young trees needs further consideration. Here again as with the water, care should be taken to see that this is not overdone. Dressings of artificial manure should be small and distributed over an ever-increasing area extending outwards from the tree-trunk. One application per year of superphosphate and potash should suffice. Nitrogen, in the form of sulphate of ammonia or nitrate of soda, may be applied with advantage twice a year, in September and again about January, using for trees in their first year slightly under half a pound well distributed at each application. Quickly acting nitrogen should not be applied late in the autumn, on the grounds that it may keep the young growth moving until the frosts arrive, with consequent damage to the tender shoots. For the first year the growth made by young orange-trees may be disappointing compared with that made by lemons under similar conditions; but this is to be expected, as orange-trees often take about a year to become established. Pruning in most cases should be confined to the removal of growth which appears below the bud, and, in the case of shoots which are too rank, a light pinching-back may be practised; but for the first year the trees should have almost a free hand to put on growth which will help them to become firmly established. Even light laterals which are obviously too low down to be of use for the permanent limbs of the tree should be allowed to remain in the meantime, as they may afford useful shelter from the rays of the sun during the hot weather. In cases where the shape of the tree is such that the trunks are exposed to the direct rays of the sun it is advisable to paint them with whitewash. This reflects much of the heat and keeps the limbs more nearly at air temperature. A good formula for whitewash is fresh rock lime, 10 lb.; salt, 1 lb.; flowers of sulphur, ½ lb. While the lime is slaking, add the salt and the sulphur, later thinning to the desired consistency.

Grading and marketing Lemons.—Although most citrus-growers forward their fruit to a central packing organization which cures, grades, and markets it on their behalf, there are still a number of growers who are curing and packing their fruit themselves. A number of these do not appear to be conversant with the regulations relating to the sale for consumption within the Dominion of New-Zealand-grown fruit. A précis of the regulations may assist in clarifying the position for those not acquainted with their provisions. All lemons sold on the market must be contained in standard packages which shall be branded with the registered number of the owner of such fruit and marked with either the words "cured" or "not cured." The words "New-Zealand-grown Lemons" must also be branded on each case. If the word "cured" is used (and it is compulsory to use either "cured" or "not cured"), then the lemons must be graded into one of the five official grades for lemons—viz., Extra Fancy, Fancy, Good, Small Grade, or X Grade, and the grade mark, together with the count, branded

on one end of each case. Lemons for inclusion in any grade shall have a minimum juice content of not less than 25 per cent. by volume. For information as to the requirements of the various grades, the grower should apply to the Orchard Instructor for his district.

—A. R. Grainger, Orchard Instructor, Tauranga.

POULTRY-KEEPING.

The Moult.

NATURE's way of assisting fowls to keep in a clean and sanitary condition is for them to shed their old coat and grow a new coat of feathers each year. This process is known as moulting. Practically all fowls moult once each year, while occasionally some moult twice in the course of twelve months, and what is known as a neck moult is not uncommon at almost any season of the year. Some very heavy producers go for two years without shedding their feathers, but this is abnormal, and it is wiser not to breed from such birds until they have moulted and rested.

Though the growth of feathers may take place at any time, the usual moulting-period is at the end of the laying-season, which, generally speaking, is during February and March. The average time it takes a healthy eighteen-months-old bird to get through the moult is from eleven to thirteen weeks. There is, however, a considerable difference in the time and manner in which birds shed their feathers, a good deal depending upon the age of the birds, when they were hatched, their health, and how the birds have been fed. The weather may also have an influence upon the time the moult may start.

Two-year-old and three-year-old birds usually take longer than younger birds, while some continue in the moult a long time, which may be taken as a sign of a weak constitution, or that such birds were over-fat or in too poor condition when the moult started. As a rule the poor producer starts shedding its feathers first, and takes a good deal longer to resume laying than the more prolific birds. On the other hand, the strongest and best producers in a flock are usually amongst the last to start moulting, and such birds often shed nearly all their feathers at once, grow their new coat, and start laying again in eight or nine weeks.

The greater majority of hens cease laying during the moulting-period, but at times a few birds produce a few eggs throughout.

Any sudden change or shortage of feed or water is likely to bring on an early or false moult; especially is this so with pullets that have just started to lay, or with hens towards the end of the year.

The usual order in which a bird moults is first the neck, then the back, wings, and body. If a bird is caught and the wings examined it will be found that the wing feathers are divided into two sections by a short feather known as the axial feather. On the outer side of the axial feather will be seen ten primary feathers which are used when flying, but which are out of sight when a bird is at rest. On the inner side are the secondary feathers which are more or less visible when the wings are folded. When a general moult starts the primary feather next to the axial feather in each wing is moulted first, and about two weeks later number two primary is dropped, and so on until the ten primary or flight feathers in each wing are moulted. It is seldom that more than two flight feathers from each wing are dropped at the same time, for this is nature's way of so providing that although a bird is going through the moulting process it can still fly and so protect itself against its natural enemies. It takes on an average about six weeks for a feather to grow to its full size.

Although the process of moulting is a natural and healthy one, it is a drain upon the system, and, as over-fat birds or those in poor condition

do not moult well, it is advisable to examine the birds, and, if some of them happen to be over-fat or a little on the thin side, they can be separated from the rest and treated suitably in order to bring them into the best condition to get quickly through the moult.

Care should be taken to see that they are free from insects; a little nicotine sulphate applied to the perches or the dusting of the birds with a fine dusting-material should rid them of vermin. It is also desirable just before or when the moult has started to treat the flock for internal parasites, which may be done by first starving the birds for about twenty-four hours, then feeding a mash of equal parts of pollard and bran, in which has been mixed a teaspoonful of Epsom salts to each three birds, and one teaspoonful of spirits of turpentine to every five birds.

The amount of turpentine required should be first mixed with the bran. Epsom salts should be dissolved in hot water, and when the salts are throughly dissolved and when the water is cold the solution is used to moisten the bran and pollard. It is well to note that best results are obtained when the mixture is given cold.

Feed when Moulting.

When casting their feathers birds do not have great appetites, but care should be taken to see that they get sufficient. However, as the moulting process advances there is a heavy strain on the system, and a more liberal supply of food is required. If insufficient food is given the growth of the new feathers is checked, but care must be taken not to fatten the hens. Though a liberal quantity is required at this time, the ration need not be so strong as that given when the birds are in full lay.

A mash made up of two measures of pollard, one measure of bran, 2 per cent. linseed-meal, 5 per cent. of meat-meal, and, twice a week, a tablespoonful of flowers of sulphur to each twenty fowls should give good results during the moulting period. The grain mixture may be made up of equal parts of wheat, barley, and broken maize.

It is important to see that a regular and liberal supply of succulent green food be given. As the moulting process is a natural one, if the quarters are kept clean and dry and the birds fed regularly they will pass through with little trouble. However, extra care and attention during that time assist nature and are amply repaid.

Forcing the Moult.

Plants have been visited where to benefit from the season of high prices for eggs poultry-keepers have tried forcing some of their hens into an early moult with a view to their coming back to lay early. In some cases this has been more or less successful, but on more occasions the results have been most unsatisfactory. In one instance 130 yearling hens were separated from the rest of the flock about the middle of December. Their mash was discontinued, and only a little more than half ration of grain was fed for about three weeks. When the moult was fairly under way they were liberally fed. The result was that by the middle of March the 130 hens were producing 50 eggs per day, and by the end of March 80 eggs per day. This production was maintained during April, but fell to 60 by the 1st May, and by the end of May 50 eggs per day were being produced, and by the end of June 40 per day were being laid. From experience the writer would recommend allowing the birds to go through a natural moult.

Export of Eggs.

During the past egg-export season a total of 11,281 cases—338,430 dozen—eggs were shipped from New Zealand to London, compared with 11,915 cases—357,450 dozen—during the 1935 season. The quantities from the respective centres were as follows: Auckland, 1,928 cases; Canterbury, 5,953 cases; Otago, 3,400 cases—of thirty dozen each.

—C. J. C. Cussen, Chief Poultry Instructor, Wellington.

THE APIARY.

Extracting.

EXTRACTING should now be in full swing in all districts. Where operations for any reason have been delayed care should be taken to see that the bees are not crowded, or they will commence to loaf, and the ultimate crop will be small. It is advisable to extract twice during the season, but where the beekeeper prefers to defer the work until the end of the flow a close watch should be kept so as to provide ample room which, however, can be done only where large numbers of spare combs are kept on hand. It is during the season when honey is coming in freely that the beekeeper realizes that his most valuable assets next to his bees is a good stock of extracting-combs. Every effort should be made to get at least twenty spare combs for each hive in the apiary, and with this number always on hand the bees are not likely to be hampered for room.

In the absence of plenty of drawn-out combs the best plan is to keep the extractor going, and thus prevent the bees from blocking the brood-combs. This usually happens unless ample room is provided, and as a result the queens are prevented from laying to their utmost, and the colonies dwindle. At no time during the working-season should the work of the queen be hindered. Care should be taken at all times to see to this important item during the flow. The honey is quite ready to extract when the combs are a half to three-quarters capped, but great care should be taken not to extract unripe honey. Numerous instances have come under notice where the practice of taking unripe honey has meant a total loss to the beekeeper.

Removing Honey from the Hive.

The usual practice followed when the time for extracting is at hand is to remove the frames one by one. If excluders are used much time is saved in picking over the combs. As the combs are taken from the hive shake the bees in front of the hive, brush off the remaining bees, and place the combs in a super for removal to the honey-house. The combs should be covered with a cloth which has been previously placed in water containing a small proportion of carbolic acid. When the season is at its height very little trouble is experienced from robbers, but in case of a stoppage in the flow the foregoing precaution is necessary. At all times the beekeeper should study his working equipment, and this is specially important when removing the honey. It will be found convenient to provide a good barrow or truck for carrying at least two full supers. Much time and labour will be saved in this way, and the tedious work of removing the honey will be facilitated.

Uncapping.

One of the most important processes in the work of extracting is that of uncapping. There are several kinds of knives for the purpose on the market, but the stiff-bladed double-edged Bingham is usually first favourite. Two of these are necessary, and they must be placed in a pan of water which is kept boiling on a small lamp. Each knife as it becomes cold is returned to the boiling water, and the hot one takes its place. Any contrivance which is used for an uncapping-can should be provided with a cross-bar through which to pass a screw or similar article, driven point downwards, to form a pivot on which to rest and revolve the combs. The comb should be placed with one end resting on the pivot and tilted slightly forward, in order to allow the cappings to fall away from the comb. Uncapping should commence at the bottom of the comb, and proceed with a sawing motion from side to side until the top of the comb is reached. The comb is then swung round on the pivot and the reverse side treated

in the same manner. Only a thin sheet of wax should be removed, but it must be done thoroughly so that every cell is opened, and at the same time the top and bottom bars should be relieved of any burr-combs which adhere to them.

Much in favour with progressive beekeepers is the steam-heated knife. This is a Bingham knife with a soldered copper plate so arranged that steam is forced through it from a rubber tube attached to the spout of a "bronchitis" kettle. An escape-tube is fitted to the opposite side, and the knife is kept at a very high temperature all the time uncapping is proceeding, thereby obviating the work and trouble of continually plunging the knives into boiling water. For uncapping heavy fully capped frames it has no equal, since an ordinary uncapping-knife becomes cold as a rule before half one side of a full comb has been uncapped.

Strainers.

It is not uncommon to find exposed for sale honey with which proper care and attention have not been paid to straining at the time of extracting. Nothing checks the sale of extracted honey so much as a layer of wax-particles, dead bees, &c., and it is surprising how few beekeepers take the necessary trouble to see their product reaches the customer free from wax and other impurities. In no case should honey be run direct from the extractor into the containers: it should be properly strained. It is the attention paid to this necessary detail that aids in the sale of the crop, and when the honey is properly treated it readily commands a higher price. Fine-gauge wire strainers are usually adopted, but even these are not sufficient to remove the smaller wax particles. In order to ensure perfect condition the honey should be passed through good fine cheesecloth before being run into the tank. Cheesecloth strainers are excellent, cheap, and are easily made, while at the same time they can be readily cleansed. They remove everything but the smallest particles of wax, which should be finally disposed of when the honey is skimmed. This latter process is an important one, and should always be carried out before the honey is put up in marketable form.

Superseding Queens.

All old and failing queens should be superseded. It is a good plan to utilize surplus queens carried over in the nucleus hives to do the work. When due attention is given to requeening the apiary there is less likelihood of queenless hives in the spring. Remove all old queens in the apiary, and especially guard against wintering any colonies not headed by a vigorous mother.

Treatment of Foul-brood.

As advised last month, no effort should be spared to treat all colonies known to be affected with foul-brood. If the work is delayed the colonies will not build up to sufficient strength to winter safely. Under no circumstances should the work be put off. Treat all infected stocks while the flow is on, and endeavour to winter none but clean colonies. There is a great risk of spreading the disease to clean colonies in the off-season, as robbing is more apt to break out. "Keep your bees clean" should be the maxim of every beekeeper. Where any doubt exists as to the complete absence of foul-brood in the apiary, an excellent plan is to mark all combs with the number of the hives to which they belong, so that when extracted they may be returned to the colony from which they were taken. If this plan is followed, even if any of the hives are diseased, the risk of spreading infection by means of wet combs will be considerably reduced.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Vegetable Crops.

AUTUMN rains on a warm soil will stimulate the growth of seedling crops sown recently: thinning will require prompt attention, and advantage must be taken during dry intervals to destroy seedling weeds before rough leaves are formed. By this means the land is kept clean and all work is greatly facilitated. A small side dressing of sulphate of ammonia along the rows of seedling crops after thinning will stimulate growth where it may be desirable. In dry localities young crops of savoy cabbage, cauliflower, &c., that are attacked by the caterpillars of white butterfly and diamond-back moth should be sprayed with a solution of arsenate-of-lead powder 1 oz. to 4 gallons (1½ lb. to 100 gallons), or dusted with a powder composed of one part arsenate-of-lead powder to five parts of hydrated lime, thoroughly mixed by placing them in a closed container and shaking. Applications are best made during the morning or evening, or on dull days when the foliage is damp and cool. Where aphides become established in the heart-bud of these plants serious damage may be done. This is best avoided by an early application of tobacco dust, or a 3-per-cent. nicotine dust, which may be made by placing 1 lb. hydrated lime in a vessel and adding 1 oz. nicotine sulphate, then closing the vessel tightly and rotating it for ten minutes: if a few pebbles are added to the ingredients, before closing the vessel, mixing will be greatly assisted. If the dust is not used at once it may be kept in an airtight vessel, but should not be held for more than one or two months.

With a view to planting out on a warm well-drained piece of land during the month of April a crop of cabbage for cutting in early spring, a seed-bed should be sown during the month of February—towards the end will often be most suitable in the warmer districts.

So soon as crops are cleared the land should be replanted; in the absence of other crops a green cover-crop should be sown. In the case of the tomato crop under glass the house should be sealed so soon as harvesting is finished, and the interior with its contents sterilized by burning screened agricultural sulphur during a windless evening. The sulphur should be used at a rate of 2 lb. per 1,000 cubic feet of air-space and placed in a number of heaps on the floor of the house so as to get a good diffusion of the gas. The next day after airing the house the plants should be cut off a few inches above the surface of the ground, and, when reasonably dry, carried out, with the strings on which they were trained, and burnt. The house then should be swept clean of dust and webs, and the roots lifted, carefully examined, and burnt. The knowledge thus obtained, together with the experience gained during the growth of the crop, gives one useful information about the diseases present and the condition of the soil—data upon which further treatment may be decided. As decay, drips, and cracks in the house seriously affect the health of crops, all repairs should be done efficiently now, especially painting, glazing, and attention to storm-water drainage. Where crops of this class are grown drainage is most important, and there are not a few houses which could be greatly improved and cropping increased by the installation of a thorough system of drainage, especially in localities where there is a heavy subsoil, or a high water-table, or a heavy rainfall. Where sterilization or change of soil is not desired the land can be cultivated lightly and sown down in a green cover-crop to be trenched in later. A thoroughly clean house and a good knowledge of the soil condition are the main factors in the economic production of the following crop.

For some years the principal losses in tomato crops have been due to virus disease of one kind or another, which, owing to the difficulty of early diagnosis, has been spread through the crop by the grower when pruning and by sucking insects. Its consistent appearance in crops from year to

year, even when every care has been taken, led to the surmise that it was seed-borne. This opinion seems now to be established as a fact. A recent journal from England states: "Extensive research carried out at the Cheshunt Experimental Station has convinced the scientists that virus diseases are carried in the seed, so that the obvious method of reducing mosaic disease is to obtain seed as free from the virus as can reasonably be guaranteed." Clean seeds are grown best under glass, with all facilities for insect-pest control; or in a cold district where such insects as aphides and thrips are less troublesome. There is also the necessity of growing not only clean seeds, but seeds of good strain. Any one who goes to this trouble and can guarantee a large measure of success in these respects should find a good demand for the seeds. A grower saving seed from his own crop should be careful not only to see that they are saved from fruit of a good type but also that the fruit was borne on a plant that was sound and of good constitution.

Small and Sundry Fruits.

When the strawberry crop is harvested the beds should be cleaned up and given a dressing of bonedust and decayed farm manure, or fowl manure, or blood and bone, thus making best use of the autumn growing-period to build up the constitution of the plants in readiness for another cropping-season. If the beds have run out and are to be cleared it should be done at once and the land planted in broccoli or other winter crops, or sown down in cover-crop for ploughing under.

As the foliage of raspberries and loganberries is rather uncertain in its resistance to chemical sprays, summer pruning should be done promptly after the harvest has been completed, as by doing so a large measure of disease control is secured. Canes and vines are cut off close to the surface of the ground and carried out and burnt. The latter part of the operation is important; it is not sufficient to stack them in a plantation or pile them in a gully to decay, as such practices are fertile means of propagating disease. After training in the new canes and vines a dressing of bonedust or other fertilizer and sowing down in a green cover-crop is often suitable treatment, especially where well decayed farm or stable manure is scarce.

It is often an advantage now to cut out water-shoots completely in gooseberries and the old wood in black currants for the benefit of the new bearing-wood. Eight or ten years is about the profitable life of these crops; but with attention and under good conditions they will remain in profit much longer. However, so soon as vigour begins to wane new plantations should be made.

Where new plantations of strawberries or bush fruits are to be planted, the preparation of the land should be completed so soon as it is cleared of other crops; the eradication of all bad weeds is of special importance. In most cases it is best to plant strawberries as soon as the plants are available, and other bush fruits in early winter. The plants should be ordered now after careful examination to ensure clean, healthy stock, for delivery as soon as they are ready for lifting.

The Homestead Garden.

In the November number of the *Journal* the subject of planning new gardens and alterations or additions to old ones was dealt with. The time has now arrived to carry out such plans of this kind that have been decided upon. If the garden is fairly large it is advisable to submit the plans to some one who has had a wide experience with this kind of work. The common desire to carry out the work oneself is readily appreciated; the planning, too, should be an expression of the owner's tastes and ideals, but owing to a lack of experience with this kind of work one or two rather crude details are apt to creep in and be overlooked until it is somewhat expensive to alter them. Small gardens are a much easier problem, and with them this risk is not so great.

With a good supply of stout pegs and a chain tape the main points of the plan should be located on the ground and marked by driving a peg firmly at each point so that the peg is not easily displaced. The portions to be sown down in grass or planted are then thoroughly cultivated and cleaned in preparation. This is the heavier and most important part of the work and is apt to be hurried, but the best results are obtained only when it is conscientiously carried out, especially in hilly or broken country. Important points are to see that the black soil is kept on top, and there is at least a depth of 6 in. of it in any portion of the lawns and rather more in the borders. Trouble with lawns is very commonly due to a neglect of this precaution. Important also is the grading of the surface of lawns and borders. Where the subsoil is open and well drained, level surfaces may have some advantage, and for some games, such as tennis and croquet, they are necessary; but usually a slight fall away from the buildings is desirable. Steep grades are best avoided so far as possible, owing to the danger of scouring in wet weather until trees and shrubs are well established, or the labour of mowing when they are sown down in grass. A smooth even-graded surface at a suitable height is evidence of good workmanship. At this stage it is best to allow time for the land to consolidate, after which the portions to be sown down in grass should be worked up into a fine seed-bed, the surface trued and firmed by rolling, the grass-seeds evenly broadcasted in calm weather and well raked in. During the period in which the land is allowed to rest and consolidate all seedling weeds should be destroyed by shallow hoeing and a dressing of fertilizers worked in. In many instances a mixture of equal parts of superphosphate and sulphate of ammonia at a rate of 1 oz. to the square yard is most suitable. Grass-seeds used for this purpose vary somewhat according to the soil and climate of the locality; those supplied by a good local seedsman are usually quite satisfactory. The sowing is best made at a rate of 1 oz. of grass-seed to the square yard. This is much heavier than that for farm pastures, but is necessary where fine grasses closely mown are required to make a good turf quickly.

The roads, walks, and service yard should then be graded, formed, and metalled. The grading here is most important, not only to give good appearance but to carry away surface water effectively and promptly and maintain the road in good repair at low cost; not to mention the convenience of clean, dry access at all times. Sometimes it is necessary to go to some trouble to put in culverts or to provide sumps to carry away the water underground; it is then a good investment and will materially contribute to the comfort and appearance of the home.

—W. C. Hyde, Horticulturist, Wellington.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

Cultures for LUCERNE, CLOVERS, PEAS, BLUE LUPINS

Now available for farmers at the following rates and supplied, post-free, in bottles of four sizes to treat seed of—

LUCERNE.	CLOVERS.	PEAS.	LUPINS.	Price.
lb.	lb.	lb.	lb.	s. d.
30	15	200	200	2 6
60	30	400	400	5 0
90	45	600	600	7 6
120	60	800	800	10 0

Full instructions accompany each lot of culture. Orders received through—

(1) DISTRICT OFFICES OF THE DEPARTMENT OF AGRICULTURE.

(2) GRAIN, SEED, AND PRODUCE MERCHANTS.

WEATHER RECORDS: DECEMBER, 1936.

Dominion Meteorological Office.

NOTES FOR DECEMBER.

DURING the first half of December the weather was, for the most part, fair to fine over the Dominion, with little rain, and in most of the North Island these conditions continued throughout the third week. Over the North Island during this period dry westerly or south-westerly winds predominated. Southland and parts of Otago also experienced, on the whole, dry and sunny weather. In the remainder of the South Island, however, it was more cloudy and humid. The last week to ten days was everywhere very wet. In the first part of the month much hay was gathered, particularly in the North Island, and shearing was well advanced. Towards the latter end both shearing and work on the land were held up, and in the North some cut hay was lost. There is abundance of pasture everywhere, in many places, indeed, a superfluity. Stock are reported to be in very good condition, but the feed is rather soft, and in some places lambs are not fattening well. The milk-yield has been well maintained. Wheat crops, till the end of the month, were in good condition, but fruit crops generally only fair.

Rainfall.—In spite of the fact that the weather was fine during the greater part of the month, the total rainfall was much above normal over the North Island. Many places in eastern and northern districts had more than double the average. In the South Island conditions were variable, and departures from normal not usually very large. The West Coast and the high country generally had less, while most of the areas with low average falls had slightly more than normal.

Temperatures.—Temperatures were almost everywhere below normal, though the departures were not, in general, large.

Sunshine.—Sunshine was above normal in North Auckland, Tauranga having 253·9 hours, and also in Southland, where Invercargill had 202·8 hours. From North Canterbury to South Auckland it was much below.

Pressure Systems.—At the beginning of the month a depression was passing away eastwards, and the weather became fine as an anticyclone moved on to the Dominion. From the 5th to the 7th several rather shallow westerly depressions crossed the South Island, causing a certain amount of rain, but eastern districts and the North Island were very little affected. From the 8th to the 15th there was little storm activity, anticyclonic conditions prevailing for most of the time over New Zealand. On the 16th a deeper depression appeared west of the South Island, and after it had passed eastward was followed on the 17th and 18th by cold southerly gales. Fairly general rain was produced by this storm, but over most of the North Island it was only light.

The first very general rain occurred on the 22nd, when the centre of a depression crossed the southern portion of the South Island. Following it, a trough of low pressure moved northwards over the Dominion, strong westerly winds prevailing to the north of it and south-easterlies to the south. The weather remained unsettled until the 24th. There were heavy falls on the 22nd from the Wellington Province southwards, while in the far South the 21st was also very wet.

Unsettled conditions developed again on the 27th, and continued until the end of the month. North-easterly gales were experienced from the Bay of Plenty northward. Except in the western and southern areas of the South Island, heavy rain was general. This was especially the case in the Auckland Province, where considerable flooding occurred, particularly in North Auckland. Much of the North Island received more than the average month's rainfall in the last three days. Warm and sultry weather prevailed in most places throughout this period.

RAINFALL FOR DECEMBER AND CALENDAR YEAR 1936, AT REPRESENTATIVE STATIONS.

	December, 1936.				Calendar Year.	
	Total Fall.	Number of Wet Days.	Maximum Fall.	Average December Rainfall.	Total Rainfall.	Average Rainfall.
	North Island.					
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	4·95	10	2·10	2·63	61·89	54·31
Russell	9·27	5	7·45	2·55	101·57	49·94
Whangarei	7·31	13	4·17	2·99	75·85	60·51
Auckland	3·30	9	1·37	3·18	52·21	49·35
Hamilton	4·09	11	1·06	3·50	54·67	49·54
Rotorua	5·86	11	1·55	3·65	67·53	54·98
Kawhia	4·02	6	1·20	3·30	59·89	53·72
New Plymouth	4·46	12	1·09	4·21	62·97	59·70
Riversdale, Inglewood	10·35	11	1·93	7·48	104·00	104·17
Whangamomona	2·38	7	0·74	5·63	67·20	77·55
Hawera	..	..	..	3·25	..	45·21
Tairua	12·35	6	4·58	4·37	69·22	64·44
Tauranga	9·45	9	4·76	3·47	63·59	52·28
Maraehako Station, Opotiki	8·00	13	2·88	2·92	73·85	53·37
Gisborne	3·45	11	1·15	2·30	44·86	45·13
Taupo	3·41	8	0·89	3·12	50·14	43·87
Napier	3·75	12	0·92	1·94	48·59	30·08
Hastings	2·81	12	1·05	1·88	40·92	31·86
Whakarara Station	5·51	13	0·56	..	57·32	..
Taihape	2·73	11	0·80	3·26	44·37	36·72
Masterton	2·55	12	0·69	2·77	47·06	38·24
Patea	5·21	12	2·64	3·52	50·92	44·81
Wanganui	3·42	10	1·50	2·69	39·47	36·11
Foxton	3·58	10	1·25	2·64	40·91	32·51
Wellington	4·43	13	1·26	2·93	56·80	42·30
	South Island.					
Westport	7·23	16	1·65	8·45	88·68	96·80
Greymouth	10·11	18	2·10	8·65	96·60	101·55
Hokitika	9·39	15	2·97	10·37	109·93	114·94
Ross	11·30	12	3·74	12·05	134·76	135·49
Arthurs Pass	9·20	13	..	14·11	143·78	161·91
Okuru, South Westland	5·78	4	3·15	10·97	155·78	144·47
Collingwood	7·24	11	1·45	7·97	97·17	97·40
Nelson	3·00	12	1·07	2·96	43·47	37·82
Spring Creek, Blenheim	2·01	9	0·65	2·10	36·07	30·28
Seddon	1·98	7	0·71	1·96	28·89	24·80
Hanmer Springs	3·19	13	1·06	3·80	59·94	45·09
Highfield, Waiau	1·83	11	0·72	2·64	42·03	33·28
Gore Bay	2·85	12	1·04	2·57	36·93	31·27
Christchurch	2·64	12	0·65	2·46	36·14	25·13
Timaru	2·77	10	1·11	2·42	30·70	22·68
Lambrook Station, Fairlie	2·75	9	1·16	2·57	30·03	24·87
Benmore Station, Clearburn	1·55	7	0·78	2·34	27·50	24·64
Oamaru	2·01	11	0·49	2·25	24·58	22·01
Queenstown	0·97	8	0·48	2·51	35·37	30·50
Clyde	1·40	9	0·52	1·76	14·66	15·22
Dunedin	5·78	16	1·68	3·47	48·06	36·65
Wendon	3·73	9	1·66	2·82	33·16	29·96
Balclutha	5·07	13	1·93	2·56	38·14	25·62
Invercargill	4·99	19	1·44	4·00	49·58	45·65
Puysegur Point	6·78	15	2·05	7·17	111·21	85·26
Half-moon Bay	3·47	16	0·97	4·90	62·30	58·79